RESTROOM USAGE IN SELECTED PUBLIC BUILDINGS AND FACILITIES: A COMPARISON OF FEMALES AND MALES

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(ABSTRACT)

Women often experience having to stand in line in order to use public restrooms. The primary purpose of this exploratory study was to determine the number and types of activities performed in the restroom, along with the amount of time spent in the restroom, as these factors might influence the revision of plumbing codes and the design of public restrooms. Data were collected by a self-administered questionnaire at four sites--an airport, highway rest area, sports arena, and conference center. The subjects were also timed. The sample consisted of 230 male and 224 female respondents.

Males and females were similar in the types of activities performed in the restroom. Urination, washing hands, and checking appearance were the three activities performed most frequently by both genders. Females were more likely to have to stand in line to use the restroom than males, though the wait was usually fewer than five minutes. At two of the sites, airport and sports arena,

females, on an average, performed more activities than males.

At all four sites, females spent a significantly greater amount of time in the restroom than did males. For female respondents the mean time ranged from 152.5 seconds (sports arena) to 180.6 seconds (rest area). For male respondents the mean time ranged from 83.6 seconds (sports arena) to 112.5 seconds (airport). There was no significant relationship between age and the amount of time spent in the restroom, for either gender at any of the four sites. The results from two sites, however, showed a slight trend toward older people spending more time in the restroom. There was no clear pattern with regard to explaining the relationship between the amount of time spent in the restroom and the number of activities performed. For males only, there were significant differences among the four sites and the amount of time spent in the restroom. For both males and females, there were significant differences between number of activities performed and site. This research indicates that females need a greater number of elimination fixtures than do males, and that revision of plumbing codes, based on further research, is needed.

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INTRODUCTION

The Problem Setting

Women often experience having to stand in long lines in order to use public restrooms. Men can be overheard asking, "What took you so long?" The title of a current best-selling book by Lewis Grizzard (1987)--*When My Love Returns From the Ladies Room, Will I Be Too Old to Care?*, is a sardonic comment on this experience. Long waiting lines for women are especially common in such facilities as airports, conference centers, highway rest areas, sports arenas during half-time, and theaters and concert halls during intermission.

There is growing public awareness of the problem of elimination fixture inequity in women's restrooms. As evidence of this awareness, at least two state legislatures, California and Virginia, have taken action to increase the number of elimination fixtures in public restrooms for women (Senate Bill No. 247 [California], 1987; House Joint Resolution No. 164 [Virginia], 1988). Also, in Illinois a state representative is planning to introduce a bill, similar to California's, this year (Shafer, 1988).

This perception of long waiting lines and elimination fixture inequity is the basis for this investigation. The contributions made by this investigation toward solving the problem are threefold. First, a rather extensive search of the literature revealed that plumbing codes and restroom design guidelines appear to lack a research base; this lack of research foundation may be the root of elimination fixture inequity. Second, a restroom queuing model which attempts to explain the way in which users of public restrooms move through the system (the restroom) is presented. Finally, the model is tested by information collected through a survey. The survey results also assess the extent of the problem and provide evidence to suggest needed revisions in plumbing codes and restroom design guidelines.

The introduction is presented in two parts. The first part is entitled, "The Structure of the Problem," and explores the factors suggested by the literature as influencing the problem. The second part, designated as the "Scope of the Problem," presents the purpose of the study, objectives, importance, definitions, limitations, delimitations, assumptions, and organization of the presentation.

Structure of the Problem

Supply and Demand

Exploration into the problem suggests that there are various factors that have an influence on restroom usage, which can be classified as either those related to supply or those related to demand (see Figure 1). Factors on the supply side include: (1) paucity of research relating to public restroom use, (2) plumbing codes which result in the specification of an inequitable number of elimination fixtures, (3) the design process (who designs public restrooms and how public restrooms are designed), and (4) service facility size (number of fixtures/features). Demand side factors include: (1) type and amount of user demand, (2) activities performed in the restroom (number and types), (3) time spent in the restroom (waiting and in service), and (4) changing work and leisure patterns (resulting in a change in the percentage of restroom users by gender). The imbalance between supply and demand, along with user and facility characteristics, may result in the following: (1) lines at the restrooms or (2) restroom use alternatives.

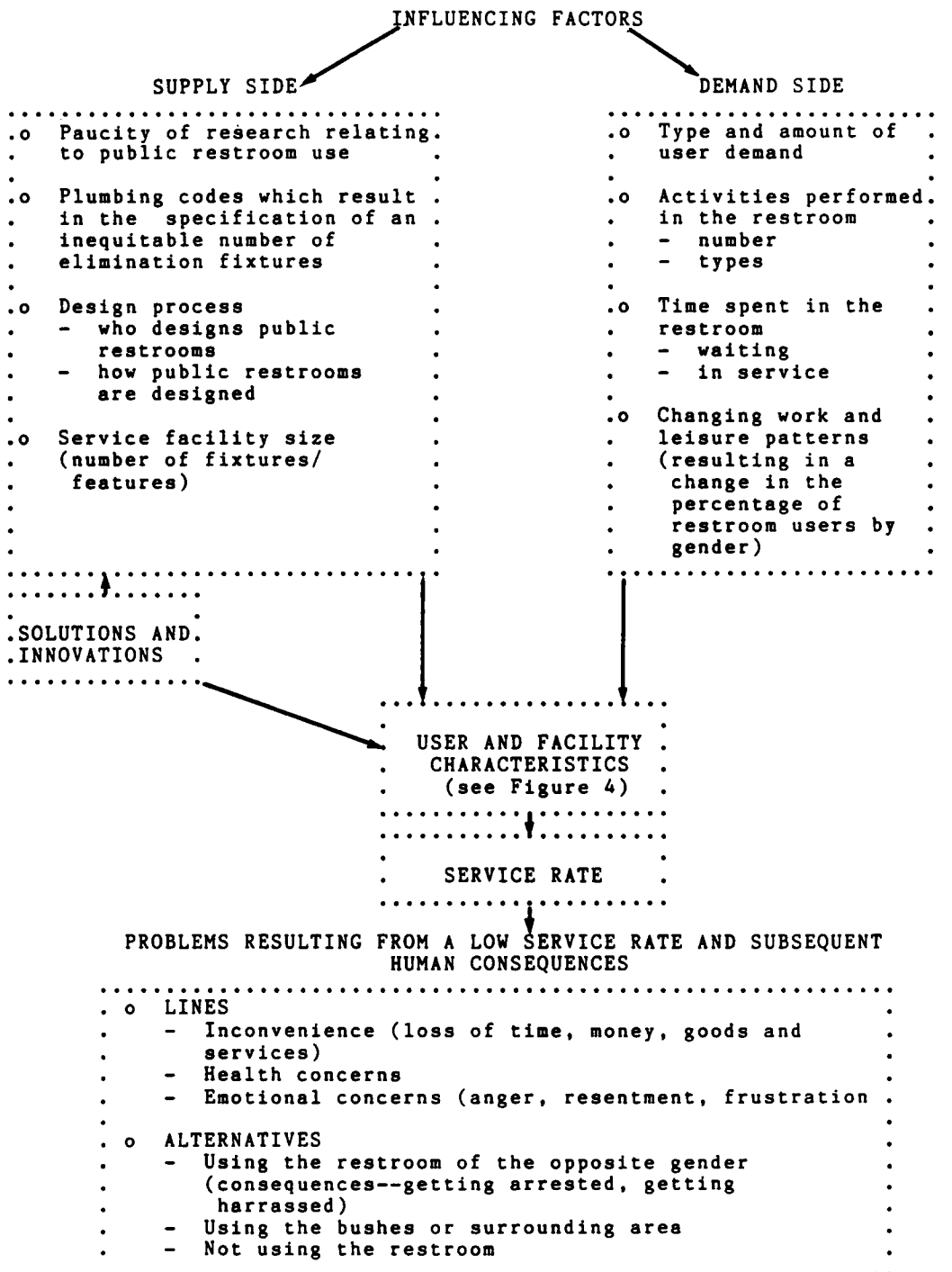


Figure 1. Structure of the Problem

Need for Research

The need for research on public restrooms has been recognized by several authors. According to Henning (1977)

> there is little information available to help building designers decide on the appropriate number of toilet facilities to provide in a building. The provision of too many fixtures results in wasted money; the provision of too few fixtures results in user dissatisfaction. (p. 1)

Wise (1979) also supports the need for additional research, stating that British "accommodation requirements in different classes of buildings have been established over many years from experience and were not originally the subject of research" (p. 22). This view is echoed by Davidson and Courtney (1976), that

> there is no apparent experimental basis for these requirements; no systematic investigation of sanitary appliance usage in offices in the U.K. appears to have been carried out.... (p. 51)

In addition, Ferguson (1972) advocates user-need studies in order to improve building codes from specification to performance. Obviously, some additional research is warranted to examine the topic and to support the need for revising the major model plumbing codes. Furthermore, it is encouraging that there is precedent for changing building codes as a result of research (Henning & Pauls, 1974). The Research Foundation of the American Society of Plumbing Engineers is currently conducting research

"...with the aim of recommending sanitary facility ratios for public buildings.... (Shafer, 1988, p.33).

The Inequity of Building Codes

Currently, the three major model plumbing codes (BOCA, Southern Standard, and Uniform) in the United States specify minimum elimination fixture requirements (water closets and urinals) for men's restrooms that are often greater than the number for women's restrooms (The BOCA Basic/National Plumbing Code/1987, 1986; Standard Plumbing Code, 1985 Edition, 1985; Uniform Plumbing Code, 1985 Edition, 1983), depending on the type of facility, the specification formula used, and the manner in which the designer specifies the fixtures. This deficit in restrooms for women is due, in part, to water closets being specified for both men and women's restrooms, while men's restrooms get an additional specified number of urinals. According to Banzhaf (1988), the current problem of elimination inequity results, in part, from

> ...making men's and women's restrooms of equal size. Since at least two urinals usually can be put in the floor space required for each toilet stall, men's restrooms frequently have a larger number of facilities (urinals and toilets) than do women's. (p. 14)

This view was supported in a statement by Senator Torres in which he indicated that

> women have to wait longer than men at many public events because men can take advantage of both urinals and stalls, and the combined number of the two facilities often is more than the number of stalls in women's restrooms. (Wiegand, 1987, page(s) unknown)

Though water closets are not often used as urinals in public restrooms by men, the potential for that use is there and is the norm in residential bathrooms. In fact, Henning (1977) found that

> ...WC's were used as urinals 22 per cent of the time;....In most cases the WC's were used as urinals when the urinals were not fully occupied, sometimes by small children accompanied by adults. Several people have stated that they are unable to use urinals owing to lack of privacy. This may account for the choice of a WC rather than a urinal for urination. (p. 2)

The type of building/facility may affect the number and types of fixtures required. From his study on public restrooms in an enclosed, suburban shopping plaza, Henning (1977) concluded that "it is probable that too many fixtures are now required in plazas" (p. 10).

It is perceived that women spend more time in the restroom, perform a greater number of activities in the restroom, and tie up fixtures/features in such a manner that other women have to wait in line for long periods. Conversely, the interpretation and application of the three major model plumbing codes often result in the specification of a greater number of fixtures in men's restrooms than in women's restrooms. This points to needed revisions in the plumbing codes, not only to make restroom

use more convenient, but to address the legal issue of "...whether equal protection and fairness require equal space, equal access, equal facilities, equal opportunity or equality of results..." (Banzhaf, 1988, p. 13).

Design Process

The supply of restroom elimination fixtures is one of the major factors influencing the problem. The resultant supply of fixtures stem from a design process that begins with plumbing codes presumably based on research, and which are often inequitable for females.

At this point it might be appropriate to ask, "Who designs public restrooms?" Kira (1976) maintains that because these spaces are perceived to be relatively unimportant, they are often assigned to the beginning architect. Furthermore, the majority of architects designing these restrooms are men, who probably do not understand the behavioral patterns of use by women in public restrooms. Brown's (1967) essay on the inadequate design of women's restrooms states that architects rely on feedback from personal experiences and the general public, but that in the case of women's restrooms, "...personal experience is impossible for the male architect, and feedback from the public unlikely" (p. 81). This view was echoed in a column by Gordon Dillow (1987).

> It seems that for reasons to which I am not privy, women as a group require a far greater number of stall toilets in public restrooms than do men. Unfortunately, the architects and engineers--most of whom are males--who design and construct public buildings often do not take this fact into account, and therefore provide an inadequate number of stalls in women's restrooms. (Dillow, 1987, page(s) unknown)

Time and Activities

Restroom activities and the time required to perform them are two of the demand side factors. There is some formal recognition that men are indeed faster than women in their use of public restrooms, documented in part by proposals to install female urinals, or urinettes, in public restrooms in order to "...offer women the same speed and convenience that urinals offer to men..." (Kira, 1976, p. 233).

Kira (1976) has associated the amount of time spent in the restroom with the activities performed, stating that

> ...the average total time spent by men, between entering and exiting, is less than two minutes and that this time period encompasses urination (40 to 50 seconds), adjusting one's clothing, rinsing the hands, drying the hands, disposing of the towel, and checking one's appearance or grooming, it is obvious that, in general, the washing activity is minimal indeed. The pattern for women is very much the same though in some circumstances the total time spent is considerably greater because of grooming activities. (p. 224)

Grooming activities are not defined by Kira, but could reasonably include various types of activities from putting on make-up to changing clothes. Henning (1977), in a

Canadian study, also alludes to grooming increasing the amount of time spent in the restroom.

Basically, restroom design has been the same for all building/facility types, with regard to the types of fixtures/features required, the only difference being the number required. The tables on the minimum fixture requirements found in national plumbing code publications make it appear that the only activities taking place in the restroom, for both men and women, are those of elimination and washing one's hands after elimination. This may not be a realistic view. Activities performed in an airport restroom might include changing clothes, while rarely would this activity take place during dinner at a restaurant.

Because of the apparent greater number and types of activities performed by women, where these activities are performed, and the length of time it takes to perform the activities, perhaps women need more fixtures, features, and space than do men. This view is not reflected in the model plumbing codes and standards in the United States. This view, however, is similar to one reported by Henning and Pauls (1974) in their Canadian study of restrooms in a theatre complex. They found

> ...that the percentage of population using the washrooms is between 15 and 30 per cent; the percentage of men using the washroom is higher than the percentage of women. Although women outnumber men in the audience, the mean duration of elimination

> fixture use is much lower for men. These findings suggest that the current requirements for twice as many fixtures for women as for men is in line with the use patterns of the washroom facilities in this theatre.... (Henning and Pauls, 1974, p. 27)

Changing Work and Leisure Patterns

Another problem that contributes to the inequitable supply of elimination fixtures in public restrooms is that plumbing codes have changed little over time, thus failing to keep pace with those changes in society that result in a changing demand for the facilities. The changing work and leisure patterns of both males and females may contribute to the inadequacy in existing public restroom fixtures/features in some buildings/facilities. Kira (1976) mentions problems such as lack of restroom facilities for males in elementary and secondary schools, while the British Parliament, once an all male institution, reports a lack of female restroom facilities. This problem was also mentioned by Gary Bruner, spokesman for the Stanford (California) Stadium, a facility which does not meet the new plumbing guidelines adopted recently by the State of California. Mr. Bruner was quoted in the San Jose Mercury News as stating, 'you gotta figure that when the Stadium was built there weren't that many women going to games in the first place' (Watanabe, 1987, p. 2A).

One argument, presented by Senator Torres of California during his attempt to obtain more restroom facilities for women, focused on the unfair treatment of women as a result of their having to wait in long lines. Torres was quoted in the Los Angeles Herald Examiner as saying,

> Women pay the same amount for a ticket to go to many of these outdoor activities and sports events, yet they are sometimes denied access to part of the evening's activities. If they pay the same amount for a ticket, they ought to be able to see the entire performance and not be delayed simply because there aren't sufficient restroom facilities. (Hull, 1987, page(s) unknown)

Service Rate Factors and Human Consequences

The supply and demand factors of the problem interact to influence the quality of service received by users of public restrooms. In addition to the previously mentioned supply and demand factors, also influencing the problem are user and facility characteristics, such as cleanliness of the fixture feature, maintenance condition of the fixture/feature, whether or not the person is carrying items, whether or not the person has with them a preschool child/children needing assistance, type/amount of clothing worn, types of activities performed, number of activities performed, whether the user is in a special user group, age of user, and gender of user. The user and facility

characteristics, in conjunction with the supply and demand factors, impact upon the service rate, and in turn, upon the formation of waiting lines and whether people will be forced to employ restroom use alternatives.

Health Concerns

This lack of consideration for user needs takes on a more important dimension for women than just user inconvenience, such as wasted time from standing in line, getting back to one's seat from intermission only to find that the play has begun, or missing a plane flight. Another more important factor relates to a woman's health and well-being. Urinary tract infections (UTIs) are more common in women than men. "Reported point incidence rates of UTIs in the US (i.e., the number of UTIs nationwide at any one time) have been approximately 3,000,000 in women and 300,000 in men" (Stumacher, 1987, p. 128). At birth, males have a higher incidence of urinary tract infections than females. But as age increases, the reverse is true, females have a greater incidence of urinary tract infections than males, with the highest incidence occurring in the postmenopausal female.

> The higher incidence of urinary tract infections in the female is multifactorial in origin: the short length of the female urethra, urethral contamination by rectal pathogens, introital colonization by pathogenic bacteria..., and the decreased resistance

> in the urethral epithelium as a result of the decreased levels of estrogen during menopause.... (Stanton, 1985, p. 340)

Female urine, especially that of a pregnant female, is more suitable to bacteria growth than male urine, due to the compositional factors of pH and osmolality.

Urination is the means by which to rid the bladder of bacteria (Stumacher, 1987) and so it is important to void frequently. Problems occur because of

> ...incomplete and infrequent voiding in the woman who is too busy or in the little girl whose mother preaches that there are only two safe places to void: your home and the local exclusive department store..., and that voiding at any other place increases the hazard of contracting an infection from the tiolet seat. Thus some young girls during childhood develop the tendency to void infrequently, a habit which continues into adulthood. (Stanton, 1985, p. 340)

In addition, "several...studies have indicated that more than 60 per cent of the women with urinary tract infections had distended bladders resulting from infrequent urination..." (Kira, 1976, p. 206). Kira (1976) also states that the higher incidence of urinary tract infections is because women tend to postpone urination due to their inability to achieve enough privacy while using public restrooms. All of the aforementioned information points to the possibility that waiting lines at women's restrooms result in females urinating more infrequently

than if there were no lines. This could, in turn, lead to increased urinary tract infections in females.

Alternatives

Alternatives for dealing with long lines at women's restrooms are not as acceptable as increasing the number of fixtures for women, but they should be mentioned. As previously mentioned, one alternative proposed in the past was to provide urinals for females. The design solution of providing urinals assumed that women were actually slower in their performance of the specific activity--urination, rather than looking at what other activities are performed in public restrooms in conjunction with urination. One of the recommendations from a British study by Crawford and Williams (1966), was, "...as it is likely that many women do not use the wc seat, a number of urinals, designed specially for women's lavatories [restrooms] could be provided" (p. 42). Brown (1967) maintains that the female urinal was "...devised, no doubt, by a lunatic scientist..." (p. 82) and is "...somewhat less convenient than the Asian squathole" (p. 83).

Another alternative to the problem of long lines is for women to use the men's restrooms,. This has been met with various reactions by males. Some thought it was funny, others never noticed, while others became angry

(Grizzard, 1987). Senator Art Torres stated "...that women who face waiting in line for half an hour 'often are driven to storm the men's room or resort to the bushes--clearly not the most safe or sanitary alternatives" (Ingram, 1987, p. 3).

Another possible alternative is that of having unisex restroom facilities. According to Kira (1976), restrooms in Japan, Italy, and France, are not separated by sex. The concepts of privacy and the separation of sexes with regard to restroom facilities, however, are prevalent in our society. According to Kira (1970), one reason for this separation by gender is the linkage between sex and elimination. Referring to the sometimes inadequate proportions of restroom fixtures at various buildings/ facilities, and the solution of unisex restrooms, Kira (1976) reports that "California has already taken a step in this direction in its new camping facilities in the state's parks by eliminating the male urinals to make unisex facilities, arguing that the public has accepted this system on the airlines" (p. 214).

Scope of the Study

As previously noted, women often experience having to stand in long lines in order to use public restrooms. Possible reasons for this include the greater number and

types of activities performed by women, where these activities are performed, the length of time it takes to perform the activities, and the often inadequate number of elimination fixtures specified by regulatory codes for women's restrooms.

Purpose

The primary purpose of this exploratory study was to determine the number and types of activities performed in the restroom, along with the amount of time spent in the restroom, of both males and females, as these factors affect the design of public restrooms. The following research questions were posed.

1. Do females spend more time in the restroom than males?

2. Are women's restrooms more apt to have waiting lines than men's restrooms?

3. What activities are performed in restrooms by males and females?

4. What are the aggregates of activities performed by males and females?

5. Which activities take longer to perform than others?

6. What is the average number of activities performed in restrooms by males and females?

7. On an average, do females perform a greater number of activities than males?

8. Does the amount of time spent in the restroom increase as the number of activities increase?

9. Does the amount of time spent in the restroom increase as the age of the user increases?

10. Does building/facility type affect the amount of time it takes to use the restroom?

11. Does building/facility type affect the number of activities performed?

Objectives

In order to address the research questions, the following objectives were developed for the study:

1. To determine the relationship between the amount of time spent in the restroom and gender of the user;

2. To determine if women's restrooms accommodate user needs and demands as well as men's restrooms;

3. To determine the difference between males and females and the types of activities performed in the restroom;

4. To determine the difference between male and female aggregates of activities performed in public restrooms;

5. To determine the average number of activities performed in the restroom by males and females;

6. To determine the relationship between the amount of time spent in the restroom and the number of activities performed;

7. To determine the relationship between the amount of time spent in the restroom and the age of the user;

8. To determine the relationship between age and number of activities performed;

9. To determine the relationship between the amount of time spent in the restroom and the type of building/facility;

10. To determine the relationship between building/facility type and number of activities performed;

11. To determine the types of activities performed at various building/facility types;

12. To make recommendations for changes in model plumbing codes in order to accommodate user needs and demands more adequately; and

13. To evaluate the methodology of the study and to make recommendations for improvement of methodolgy for further study.

Importance of the Study

The results from this study should be valuable to model code groups in establishing new plumbing fixture requirements where needed. Architects, interior designers, and engineers also could use the results to design public restrooms which would meet user needs and demands better. Public health officials could use the results to lobby for better restroom facilities for women in order to (1) promote women's health and well-being, through decreasing the incidence of bladder and urinary tract infections among women and (2) decreasing time ineffectively used in waiting to use facilities. Finally, owners and managers of various buildings or facilities might also be interested in the findings, in order to provide better restroom facilities for their clients or customers.

Definitions

Fixtures/features: Within the restroom, the fixtures are toilets (or water closets), urinals, and sinks. All else within the restroom is in the category of features, including mirrors, counter tops, paper towel holders, hot air driers, toilet tissue holders, and soap dispensers.

Peak: One or more periods of concentrated or heavy demand placed on a restroom by the users.

Nonpeak: One or more periods of intermittent or continual demand placed on a restroom by the users.

Respondents: Those subjects who were timed and completed a questionnaire.

Nonrespondents: Those subjects who were timed, but refused to complete a questiionnaire.

Restroom: (Also referred to as a public restroom.) Any provision in a public building/facility for the primary purpose of elimination. It may include bathing facilities.

Limitations

The study was inherently limited by the following:

1. The willingness of the sample population to participate in the study;

2. The willingness of the sample population to complete the questionnaire in a truthful and complete manner, due to the relatively sensitive subject;

3. The willingness of the owners or managers to allow the buildings/facilities to be included in the study;

4. Possible weaknesses in the design of the instrument (questionnaire) (see Appendix A); and

5. Possible weaknesses of the data collection techniques.

Delimitations

The study was limited to the following by the investigator:

1. Only four types of buildings/facilities were studied; and

2. All data were collected from outside the restrooms.

Assumptions

The following assumptions were made:

1. Waiting lines are a problem in women's restrooms; and

2. Queuing theory is applicable to the study of restroom usage.

Organization of the Remaining Chapters

The remainder of the dissertation is comprised of chapters 2 through 6. Chapter 2 consists of the review of literature and conceptual framework and Chapter 3 focuses on the methodology of the study. Chapter 4 presents some background information pertaining to the study, including a brief history of plumbing codes, plus descriptions of the restrooms used in the study. The results of the study are in Chapter 5. Chapter 6 contains the summary, conclusions, implications, and recommendations for further research.

Chapter 2

REVIEW OF LITERATURE AND CONCEPTUAL FRAMEWORK

This chapter has three sections. The first section presents a general explanation of queuing theory and its applications. Section two describes the restroom queuing model and focuses on literature related to various components of the model. This is followed in the final section by hypotheses derived from the model and literature.

Queuing Theory

Early on, queuing theory was applied to the telephone, later became used for traffic situations, and today is most often used with computers (Carmichael, 1987). Other uses include construction and mining engineering (Carmichael, 1987); teller windows at banks, office paper flow, manufacturing assembly lines, scheduling surgery, emergency room scheduling (Panico, 1969); the number of CRT terminals to have in offices (Copenhaver, 1984); the determination of the optimal number of beds needed in a hospital Intensive Care Unit (Yang, 1981); case scheduling in the courts (Kwak, Kuzdrall, & Schniederjans, 1984); and "...to determine the number of police patrol cars needed,

and their deployment across geographical areas and shifts" (Lawless, 1987, p. 245).

Queuing theory has been utilized in restroom usage research in Great Britain by Davidson and Courtney (1976) and in Canada by Henning (1977). According to Gross and Harris (1985), "queueing theory was developed to provide models to predict behavior of systems that attempt to provide service for randomly arising demands..." (p. 10). Panico (1969) states that the use of queuing theory changes "...the decision-making process, with respect to waiting lines, from a qualitative to a quantitative one, thereby improving the chances of deciding correctly" (p. 4).

In its most simplistic form, according to Disney (1987), queuing theory consists of an unpredictable demand on a system, coupled with the varying amounts of time it takes people to use the system. These two factors together determine whether or not there is a waiting line to use the system.

$$L = f(D, T)$$

where L = length of waiting line

D = demand placed on the system

T = amount of time to use the system

In addition, Disney (1987) stated that real demand is difficult to ascertain, because it is comprised of actual demand, which is measurable, and induced (i.e., created) demand, which is unmeasurable.

In this instance, the system is a public restroom. Two examples are presented here and serve to illustrate queuing theory as it is applied to public restroom usage. No matter how quickly one uses the fixture/feature, for example the water closet, if 50 people are waiting to use the water closet, in all probability, there will be a waiting line. The reverse is also true. Even if a person spends a considerable amount of time in the stall, for example 15 minutes, if there is no demand to use the stall, no waiting line will result.

Panico (1969) states that "A basic queuing model has two distinct parts: The waiting line and the service facility" (p. 5). With respect to line length,

> A short line with quick service is required when waiting has a high premium, while a long line with average service may be required when the premium is low. Waiting is usually an economic necessity since most attempts at designing a service system to satisfy demand instantaneously have proven too costly. (Panico, 1969, p.5)

Taylor (1982) concurs that service costs and waiting costs must be considered in the decision-making process.

Progressing from the aforementioned simplistic explanation, the following more complex explanation will

assist in a greater understanding of queuing theory by introducing some additional factors. According to Taylor (1982), there are four general categories of queuing systems: (1) single-server/single queue; (2) multiple-server/single queue; (3) single queue/single-servers in sequence; and (4) single queue/multiple-servers in sequence, with the first two types being the most common.

Other factors which must be taken into consideration include: (1) queue or service discipline--the order in which users are served; (2) calling population--where do the users come from; (3) arrival rate; and (4) service rate (Taylor, 1982). According to Taylor (1982) queue or service discipline can assume five forms: (1) first-come, first-served; (2) last-in, first out; (3) random; (4) prearranged schedule; and (5) alphabetical order. Carmichael (1987) lists five types of queue or service disciplines: (1) first-come, first-served; (2) last-come, first-served; (3) random; (4) batch; and (5) state dependent. With state dependent service, the server may actually serve faster when the queue is long. In addition, Carmichael (1987) specifies four types of service mechanisms: (1) parallel (multiple service facilities); (2) series (multistage service); (3) cyclic (repetitive moving through the system); and (4) network (the user has options to travel along different paths of the network).

The calling population can be of two types, (1) finite (i.e., limited) or (2) infinite (i.e., unlimited). An infinite calling population is the most common. Arrival rate consists of the mean number of users entering the system during a specified time period. According to Carmichael (1987), it is common for those arriving at the system to do so in a Poisson distribution. A Poisson distribution assumes that arrival at the system is random, but at an average rate which is constant. But those arriving at the system may arrive in bulk, that is, in groups (Carmichael, 1987). Service rate consists of the mean number of users being served during a specified time period. This distribution is also random, due to the multitude of variables which affect the service rate. Besides being random, this distribution should also be exponential (Taylor, 1982).

Other factors which can complicate the queuing system include: (1) balking, (2) reneging, and (3) jockeying. Users are said to "balk" if they refuse to enter the system because the queue appears too long, and users "renege" if they leave the system before being serviced, while users "jockey" if they change queues (Taylor, 1982). Another queue characteristic is whether the queue is restricted or unrestricted. A restricted queue is one which has a limited or finite amount of space

for the formation of a queue and thus arrivals to the queue may actually be turned away.

Some interesting concepts associated with waiting are presented by Morrow (1984). He says that to make someone wait is to exert power over them, and that people who wait feel powerless. He also maintains that "waiting is a form of imprisonment. One is doing time--but why? One is being punished not for an offense of one's own but often for the inefficiencies of those who impose the wait" (Morrow, 1984, p. 65).

Fitzsimmons and Sullivan, at the University of Texas, present various ways to make waiting endurable. Some of their suggestions include: (1) having a single queue with multiple servers, so that users do not experience the feeling of having gotten into the wrong line; (2) giving the user something to do while waiting; and (3) concealing the waiting line (The Waiting Game, 1984)

Restroom Queuing Model and Its Components

Using selected information presented by queuing theorists (Carmichael, 1987; Disney, 1987; Panico, 1969; Taylor, 1982;) a restroom queuing model was developed (see Figure 2). This model is based on the following assumptions: (1) restrooms operate on a first-come/ first-served basis; (2) a single queue exists (therefore

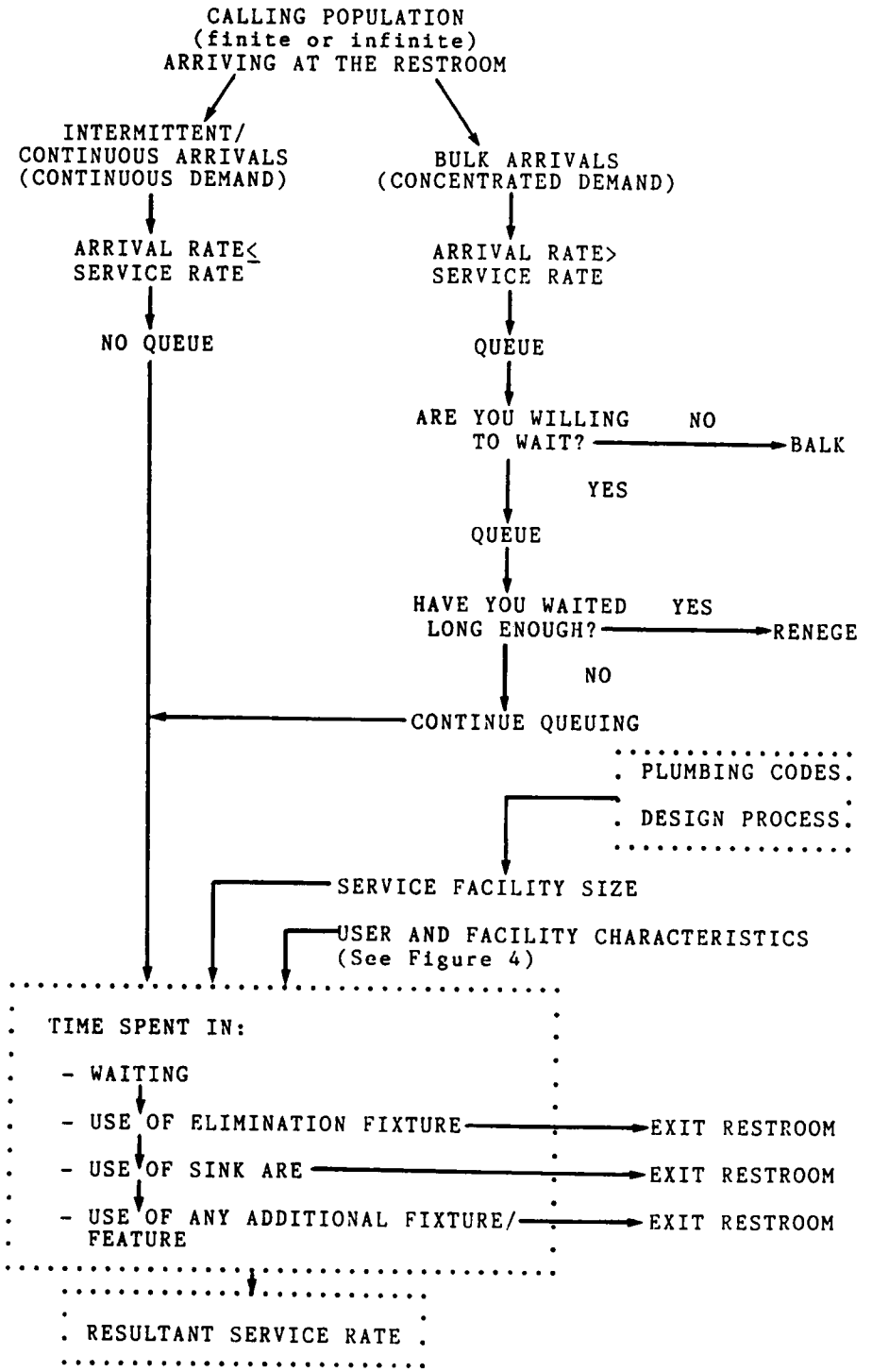


Figure 2. Restroom Queuing Model

jockeying does not exist); and (3) there are multiple servers in sequence. First, depending on the building/ facility type, the calling population or input source will either be finite or infinite.

Next, arrivals are referred to in terms of arrival rates. When more people arrive at the system than can be served, in this instance a restroom, a queue will form. When the arrival rate is greater than the service rate, it is possibly due to bulk arrivals or concentrated demand. At other times, when the arrival rate is less than or equal to the service rate, arrivals are more on a continual basis, constituting intermittent or continual demand.

If there is a queue, people have the option of not entering the queue to use the restroom. This is known as balking. If people are willing to wait, they join the queue. After a time, people may feel that they have waited long enough and thus leave the queue before getting to use the restroom. This decision is known as reneging. Those now remaining will probably wait in the queue until they are able to select and use the fixtures/features of the restroom.

The service rate of the restroom, which is an important component with regard to whether or not a queue will form, is dependent on three factors (see Figure 3), (1) user demand, (2) service facility size (number of

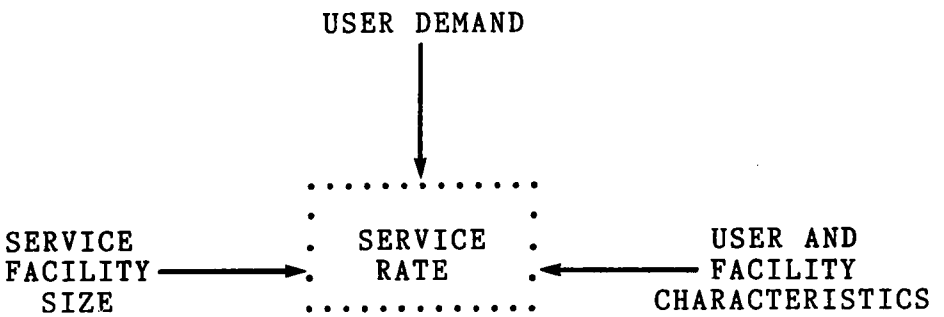
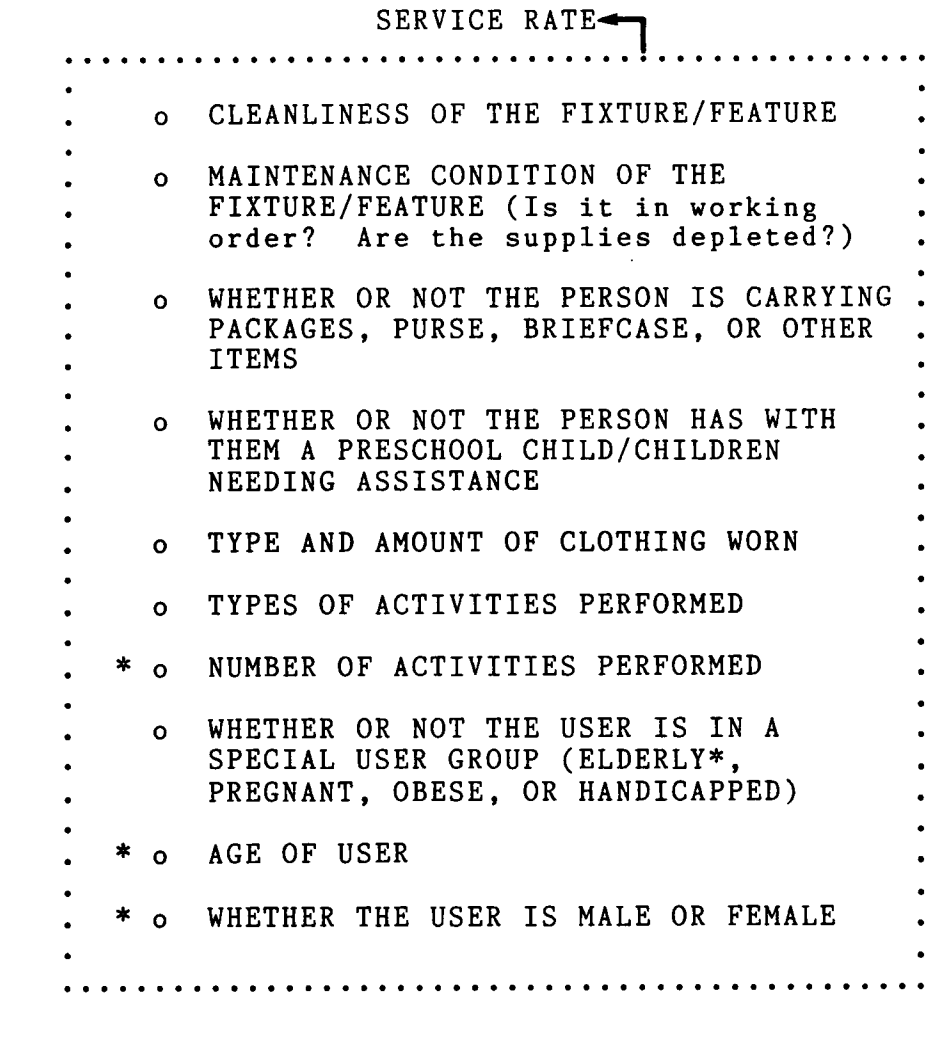


Figure 3. Factors Affecting the Service Rate

fixtures/features), and (3) user and facility characteristics (see Figure 4). Service facility size, in turn, is based on plumbing codes and the design process. It is hypothesized by the investigator that the user and facility characteristics which affect restroom service rate are the following: (1) cleanliness of the fixture/feature; (2) maintenance condition of the fixture/feature (Is it in working order? Are the supplies depleted?); (3) whether the person is carrying packages, purse, briefcase, or other items; (4) whether the person has with them a preschool child/children needing assistance; (5) type and amount of clothing worn; (6) number and types of activities performed (feminine hygiene, changing clothes, breast feeding, etc.); (7) whether the person is in a special user group (that is, elderly, obese, pregnant, or handicapped); (8) age of the user; and (9) whether the user is male or female. The following section of the paper will present evidence for the inclusion of these specific variables in the model and a summary of their treatment in the literature.

Demand

User demand is a major component of the restroom queuing model. Type and amount of demand figures importantly into whether a queue will form. Miller (1976)



*Variable tested by hypotheses

Figure 4. User and Facility Characteristics Affecting the Service Rate (a submodel)

proposes that all systems are comprised of the four elements of time, space, information, and energy. According to Fruin (1981), with respect to time,

> As long as the demand or arrival rate is less than the processing rate of the element...pedestrian traffic moves freely. However, when the demand rate exceeds the processing rate of an individual element, even for a short period, the traffic flow is interrupted, resulting in delay and queuing. (p. 3)

An illustration of continual demand vs. concentrated demand is presented by Fruin (1981). He states that arrivals to a facility, such as a stadium, are often spread out over time and have no problems with lines, while departures are en masse, with everyone wanting to exit at the same time, resulting in long lines.

Another example of a concentrated level of demand is given by Kira (1976). He reports that airport restrooms located in the gate areas are "...most heavily used by deplaning passengers, which often results in bunching and extreme temporary crowding" (p. 219).

Davidson and Courtney (1976) found that in office buildings lunch time was peak demand time for the restroom, with only one exception. Water closets in men's restrooms "...were most in demand near the start of the working day" (p. 53).

An important component in the queuing formula is the arrival rate. Henning (1977) reported that for men, the

mean arrival time was "...0.92 people per minute per washroom and for women it is 0.98 per minute per washroom" (p. 4) at an enclosed, suburban shopping plaza.

A computer program was used to simulate restroom usage (Henning, McPhie, & Webster, 1975). The data used in the simulation came, in part, from the study of restrooms in an enclosed, suburban shopping plaza (Henning, 1977). The benefit of computer simulation is that it allows one to vary the number of fixtures in a restroom and to then compute the resultant waiting lines.

The computer simulation calculated that males must wait in line longer than females in order to use a water closet, due to water closets being used by men primarily for defication, an activity which takes a greater amount of time than urination, while women use the water closet for both urination and defication, resulting in an average time lower than that for defication. With 10 percent of males waiting, the average wait was 70 seconds, compared to the average wait of only 30 seconds with 10 percent of females waiting. And with 25 percent of males waiting, they had an average wait of 180 seconds, four times longer than the average wait of females, who had only an average wait of 45 seconds (Henning, 1977).

With regard to the longer waiting times experienced by males, Henning (1977) explored the water closet to urinal

ratio to examine what effect this had on waiting. The calculations of the computer simulation suggest

> ...that a ratio of WC's to urinals of between two and four is appropriate. A lower ratio results in higher waiting times but reduces the use of WC's as urinals with a ratio of three or four WC's per urinal the waiting times are lowered and the use of WC's as urinals is slightly increased. All ratios above this level, waiting times do not increase but use of WC's as urinals does. (Henning, 1977, p. 7)

Computer simulation was also used to examine waiting lines at wash basins. It was calculated that wash basins had a low wait time, with a typical wait of only five seconds. Even with 20 percent of the people waiting, the wait time was less than 30 seconds (Henning, 1977).

As a result of the computer simulations, it was concluded that "washroom efficiency increased as the number of fixtures in the washroom increased" (Henning, 1977, p. 10) and that it was more efficient, given an equal number of fixtures, to have one large restroom than to have several smaller ones (Henning, 1977).

Not only are there the problems associated with level of demand, but a further complication concerns the accuracy of determining demand. According to Henning (1974),

> population is a basic characteristic of building occupancy important in both building design and regulation. The design of exits, washrooms and elevators depends on demand factors calculated from population estimates. In occupancies such as a theatre with fixed seating, the maximum number of persons expected to occupy a given space can be

> easily determined at the design stage. In other occupancies such as stores and malls, there is little information available on which to base population estimates. (p. 1)

This appears to be true for many building/facility types. Still another complication involves legal occupancy vs. actual occupancy, in that "Plumbing fixture requirements are to be based on the maximum legal occupancy and not on actual or anticipated occupancy" (Packard, 1983, p. 636).

It is apparent that accurately determining type and amount of demand on the restroom would make it possible to design restrooms which more adequately meet user needs and demands.

Cleanliness

Women's restrooms tend to have a problem with cleanliness, especially in the stalls and more specifically on the toilet seats. This condition appears to increase the time it takes for a woman to use the elimination fixture. It may also discourage use altogether, thus contributing to the health problems previously mentioned. Kira (1976) maintains that this is because of a "...lack of satisfactory provision for female urination" (p. 232). In the United States, women at home tend to sit on the toilet to urinate. In public restrooms, however, women often will not sit on the seat (e.g. fear of catching a venereal

disease), but hover over it instead. Also, a survey conducted in Great Britain reported that 96 percent of the women never sit on the toilet in a public restroom (Kira, 1976). The hovering position is

> ...awkward and difficult to maintain and more often than not, especially when one is in a hurry, results in urine's being dribbled on the seat, the bowl, and the floor. Obviously, each successive user feels, in turn, even more justified in avoiding contact with the soiled fixture and puddle on the floor and so tends to assume an increasingly extreme posture with the inevitable result that her performance is, in turn, increasingly poor. (Kira, 1976, p. 232)

As previously mentioned, another problem is that women often postpone urination for so long that the bladder is full, almost to bursting, thus the act of urination is rather careless (Kira, 1976).

Technology may contribute to solving the problem of restroom cleanliness and thus reduce the amount of time it takes to use the restroom. The technology has been around since at least 1937 for a self-sterilizing toilet seat (Self-Sterilizing Toilet Seat, 1937; Wilson, 1937). One such toilet seat was sterilized by live steam. The process was quick--taking only about 90 seconds and, it would fit on most standard toilet bowls (Self-Sterilizing Toilet Seat, 1937). Therefore, it should have been relatively easy to convert existing water closets.

Currently, a French company has a system which works with three toilet seats, which

> ...are used in succession. In just three seconds a clean and disinfected seat comes into place. Inside the cabinet, the two others are cleaned and dried. After each use disinfectant is added to the water. This mixture is also used to wash the bowl. (Speedynett, n.d., n.p.)

This system also works on most existing toilet bowls. Users of both systems would be assured of a sterile seat upon which to sit without fear of catching a disease. If people felt comfortable sitting on the seat, perhaps they would cease to hover, resulting in a cleaner stall. Cost of these toilet seats could be a factor in their limited use.

Another current product which allows women to face the toilet and urinate in the standing position, is a disposable paper funnel (Cassidy, 1987). Since sterilized toilet seats and disposable paper funnels are not commonplace, and it is recommended that people do not sit on the toilet seat in order to protect themselves from germs, perhaps it would be advisable to place a seat cover of some type on the toilet prior to sitting down. The cover could be one of the paper or plastic types, or even regular toilet paper. The plastic covers are relatively new--just press a button and they dispense automatically (Cassidy, 1987). Any of the above suggestions could

eliminate hovering, thus making for a cleaner stall, but all of these precautions may increase the time it takes to use the restroom, especially for women.

Van der Ryn (1978) discusses the physiological benefits of squatting for the purpose of defication. He goes on to explain that conventional toilets are not designed for the squatting position, but rather for the sitting position. His solution is for the person to squat on the toilet seat and states "You'd be surprised how many people do!" (p. 31). If people do actually squat on the toilet seats of public restrooms, this could contribute to the soiling of the seat from dirt from people's shoes. An interesting point made by Kira (1976) is that black toilet seats are rarely used in residential bathrooms, being more commonly used in public restrooms. Could the reason for this be to hide the soil residue?

Crawford and Williams (1966), maintain that the public may have no control over restroom design and the fixtures/ features contained within, but they do believe that "...the sanitary condition of our lavatories is often due directly to public misuse" (p. 36). They reported that almost one-quarter of the 139 women observed left the seat wet. They also found that the women did not use the seat due to its being uncomfortable, rather than because it was wet (Crawford & Williams, 1966).

The aforementioned cumulative soiling effect is also true for the sink and urinal areas. Kira (1976) reports of the urinal area, "Once the floor is wet, one wishes to avoid stepping into the puddle and so stands back and, of course, adds more to the mess" (p. 211).

This problem of soil residue in women's restrooms has been around a long time. Ellis (1936) reports on a woman, with a tendency toward Undinism (i.e., sexual gratification obtained from urination), who grew up during the Victorian period. The woman confessed that she would have enjoyed voiding on the floor of the restroom, but would have felt guilty if she had met someone on her way out.

Another cleanliness factor discussed by Kira (1976) pertains to the use of paper towels, which are the preferred method of drying one's hands. Used paper towels, however, end up on the floor, resulting in a messy restroom. Warm air dryers were installed in order to combat this problem. According to Kira (1976), however, these dryers take more time to use. Furthermore, they are "...loathed with a passion by many" (Kira, 1976, p. 226). An additional problem occurs when "in large and busy facilities, there is also often an insufficient number of blowers for the volume of traffic, and this results in a bottleneck in the rapid and efficient processing of users" (Kira, 1976, p. 226).

In conclusion, it apppears that cleanliness may be a major contributor to the amount time required to use the restroom. The technology which could be used to maintain a cleaner restroom is not in common use at this time.

Maintenance Condition

Lack of maintenance, including depleted supplies, presents a serious problem in restrooms and can be a factor affecting the service rate.

> A survey in New York City in 1972 revealed that of some 500 public facilities inspected in subways, parks, bars, and restaurants, 368 'were without paper, soap, running water, or had broken fittings on commodes,' and further that 90 per cent of the rest rooms in the city's subway system were closed down completely. (Kira, 1976, p. 215)

Perhaps depleted supplies are more of a problem in women's restrooms than in men's, since men generally do not follow the female custom of blotting after urination (Kira, 1976), and 39 percent do not wash their hands after urination (McCall, Gleye, & Singer, 1971). It then follows that men do not have to take the time to look for supplies such as toilet tissue, soap, and paper towels, or perhaps their supply is rarely depleted since it is not used as often.

Another problem concerns water closet blockage with sanitary napkins, a product unique to women's restrooms (Kira, 1976). Still another problem concerns the blockage

of sinks. A British study by Crawford and Williams (1966) found that even though the restroom had a separate area for combing hair and putting on make-up, the women preferred to use the mirrors over the sinks. The result was that hair stopped up the sink drains.

Items Carried

Where to put the things one is carrying in order to wash one's hands, use the water closet, or urinal presents quite a problem in most restrooms. At least, men have the ability to hold a briefcase and newspaper under their arm while urinating (Kira, 1976), while women do not have this ability. Items a woman is carrying must be placed somewhere in the stall, which has little or no storage space. Women usually use the coat hook on the back of the door, the floor, or the top of the toilet tissue dispenser as storage space. Wet floors, common in both men's and women's restrooms make them less than an ideal storage space (Kira, 1976).

Crawford and Williams (1966) made a recommendation, from their study, that "shelves (for parcels, etc) should be provided both inside cubicles and beside washbasins. Wall-mounted hooks for coats, are needed in cubicles, even though replacement is likely to be a continuing cost" (p. 42). According to Kira (1976), lack of storage space

"...may be a forgivable oversight in men's facilities, it is inexcusable in women's facilities, where virtually every user is likely to be carrying at least a purse" (p. 237). In one study, however, 39 percent of the men had one or more items with them (McCall, Gleye, & Singer, 1971). And, it was reported that men also had trouble finding a place to put the object(s) they were carrying (McCall, Gleye, & Singer, 1971).

A recent article on protecting yourself against germs in public restrooms (Cassidy, 1987) advises against putting items on the floor of the stall, suggesting "instead, use a hook, if one is available, or hold things in your hands" (p. 198). It is logical to assume that having to hold your belongings in your hands while using the water closet could slow down the process and make the task quite awkward.

Children

Kira (1966) reports that, in general, children under the age of five require at least some assistance with personal hygiene activities. This corresponds with information on toilet training presented by Lasky (1984). She reports that toilet training does not take place as early as it used to. Furthermore, "the average child cannot be successfully toilet trained before the age of about 30 months. While girls are often trained by 2, boys

may not be trained before 3 or later" (p. 4). Lasky (1984) goes on to say that "any time before the age of 4 is normal..." (p. 5). Gallender (1980) echoes these views by stating that "most children are toilet trained by three years of age or at least by the time they enter school" (p. 277).

The investigator believes that women, more often than men, take the young children (both males and females) into the restroom with them, though no research literature has been found to support this view. In connection with the California restroom equity legislation and the problem of long lines at women's restrooms, "Assemblywoman Teresa Hughes, D-Los Angeles, said mothers rather than fathers usually get the chore of taking childen to the restroom, making the problem worse" (Matthews, 1987, page(s) unknown). Sue Brock, of the Children's Alliance, was quoted, in The Sacramento Bee, as saying 'But it's really not so funny when you have a child wetting his pants when you watch...men walking in and out of their restrooms' (Matthews, 1987, page(s) unknown).

A complication involving young male children is their sometimes inaccurate aim (Kira, 1976), which could contribute to soil residue around the elimination fixture. If females do indeed take their young male children to the restroom with them, then the untidiness takes place in the

stalls of the women's restroom, adding to an already acknowledged problem. Lasky (1984) also reports that young male children have trouble aiming and need practice in order to learn control.

Traveling with a child who is in the process of being toilet trained may present some problems, one reason being that "some children love the idea of a strange toilet, while others will absolutely refuse to use one" (Lasky, 1984, p. 60). Lasky (1984) has some recommendations for making travel easier. One recommendation for success includes the use of an adult toilet seat for training in conjunction with a toilet-seat adapter, rather than a potty chair. A folding toilet-seat adapter is available on the market. And, since it folds up to a five-inch square, it will fit easily into a bag or purse. This results, however, in still another item being carried into the restroom, though it is not as large and cumbersome as a potty chair. Another recommendation is to take the child around town and introduce him/her to restrooms in facilities, such as a department store, in hopes that the child will become used to using toilets other than the one at home.

Recommendations by Crawford and Williams (1966) with regard to children, are: (1) "in men's lavatories where bowl urinals are installed, some should be provided at a

lower level for the use of young boys" (p. 42) and (2) "in women's lavatories, potties for babies should be available, together with running water for washing them out and appropriate means of sterilisation, perhaps in special cubicles" (p. 42).

Mothers who are breast-feeding their babies experience other problems, such as where to nurse their babies. In a recent letter to Ann Landers (1987), a nursing mother wrote to share her experience of trying to nurse her baby in a quiet area of a mall. She was rudely told by two passers-by that she should either cover up or go into the restroom. The mother's complaint to Ann Landers (1987) was "...that most bathrooms are not equipped for nursing mothers. They do not have even a chair. I refuse to sit on a dirty floor for the half-hour it takes me to feed my child" (p. 7).

Women have told the investigator that they nursed their babies inside of the stall, sitting on the toilet. One mother reported that the sound of flushing toilets greatly upset her baby during feeding. All said that in their case there was really no other alternative available to them. The effect of this is to render a water closet unavailable for the use of others for a period of about 30 minutes.

If an airport has diaper-changing facilities, they have usually been located in women's restrooms, because of the traditional practice of the woman as principal care-giver. This is going to change soon with the addition of diaper-changing tables in men's restrooms at Bradley International Airport, located in Windsor Locks, near Stamford, Connecticutt. This change is due to an increase in the number of men traveling with children. Some airports have dealt with this problem by constructing nurseries or special diaper-changing rooms, open to both sexes (Ravo, 1987). Having an appropriate and separate place to perform child care activities should help to alleviate some of the congestion in the restroom caused by parents diapering a baby or performing other child care activities. Even having a separate child care area within a restroom aides in expediting child care tasks.

Clothing

When men urinate, they can just pull back their overcoat and jacket and thus have no need to disrobe (Kira, 1976), making this activity a fairly quick one for them. Conversely, "in most instances today, a woman has to disrobe substantially in order to urinate in any manner..." (Kira, 1976, p. 234) and of course this takes additional time. In addition, clothing management problems were

listed as one of the major reasons for the failure of the female urinal (Kira, 1976).

Activities

Kira (1976) reported on various types of anti-social and illegal activities that take place in public restrooms, such as drug dealing and bombings, which have been studied rather extensively. Little has been found by the investigator which describes in any detail many conventional or expected restroom activities, such as putting on make-up, changing clothes, brushing teeth, diapering a baby, or even elimination.

Basically, only the primary restroom functions, time spent at the sink, time spent at the urinal or urination, and time spent in the use of the water closet, have been studied and timed. Some of the findings include: (1) on an average, hand washing takes one minute or less (Kira, 1976); (2) men spend an average of 18 seconds at the wash basin, while women spend an average of 19 seconds (Davidson & Courtney, 1976); (3) males spend an average of 14 seconds at the wash basin, compared to an average of 20 seconds for females (it was speculated that the mean time would have been longer for females if there had been mirrors over the wash basins) (Henning, 1977); (4) males spent an average of 40 seconds at the sink (McCall, Gleye,

& Singer, 1971); (5) while the average lavatory time for males in a military installation was 4 minutes, this, however, included washing hands, face, and teeth, in addition to shaving (Graus, 1957); (6) 45 seconds is the average time for male urination (Graus, 1957); (7) males spent an average of 39 seconds at the urinal in one study (Davidson & Courtney, 1976), 47 seconds in another (McCall, Gleye, & Singer, 1971),and 35 seconds in still another (Henning, 1977); (8) average time spent by males in the water closet was 289 seconds in one study (McCall, Gleye, & Singer, 1971), 267 seconds in another (Davidson & Courtney, 1976) and 221 seconds in still another (this did not include its use as a urinal) (Henning, 1977); (9) while the average time spent in the water closet for females was 80 seconds in one study (Davidson & Courtney, 1976) and 92 seconds in another (Henning, 1977); and (10) average defication time for males was 162 seconds (Graus, 1957) (see Table 1). A recent study by Tran found that males at highway rest stops spent an average of 45 seconds in the restroom, while females spent an average of 79 seconds (Equality Opportunity in the Restroom, 1988; More Time Means More Toilets, 1988).

Other time-related findings by Henning (1977) include: (1) the average male time use of water closets when used only as urinals was 54 seconds; (2) the average male time

Table 1

Research Studies and Average Times Associated with Various Restroom Activities

	Delay of onset (males)	Micturation (males)	Urination (males)	Defication (males)	W/C use, total (males)	W/C use, as urinal (males)	W/C use, not as urinal (males)	W/C use, total (females)	Elimination fixture use (males)	Elimination fixture use (females)	Sink use (males)	Sink use (females)	Handwashing (sex not specified)	Non-elimination activities (males)	Non-elimination activities (females)	Total time in restroom (males)	Total time in restroom (females)
Davidson & Courtney (1976)			39s		267s			80s			18s	19s					
Graus (1957)			45s	162s							4m						
Henning (1977)			35s		182s	54s	221s	92s	89s	92s	14s	20s		32s	104s	117s	185s
Kira (1976)													≤1m[1]				
McCall, Gleye, & Singer (1971)			47s		289s						40s				1.92m		
Middlemist, Knowles, & Matter (1976)	8.4s[2] 6.2s[3] 4.9s[4]	17.4s[2] 23.4s[3] 24.8s[4]	25.8s[2] 29.6s[3] 29.7s[4]														
U.S.Department of Commerce (1924, 1929, 1932)					7.1m[5] 4.25m[6]			3.97m[6]									

s = seconds m = minutes

[1]Study reported by Kira [2]Close [3]Moderate [4]Control

[5]Data provided by C.T. Coley, observations from the Equitable Building, New York, NY

[6]Data provided by Charles F. Horan, observations from the Hood Rubber Co., Watertown, MA (factory)

use of a water closet, including when it was used as a urinal was 182 seconds; (3) the average time use by males for elimination fixtures was 89 seconds; (4) the average time spent by males on nonelimination activities was 32 seconds, while the average was 104 seconds for females; and (5) the average total time spent, by males, in the restroom was 117 seconds and females spent 185 seconds. McCall, Gleye, and Singer (1971) found an average total restroom time use by males to be 1.92 minutes (115.2 seconds). With respect to additional restroom activities and behavior, McCall, Gleye, and Singer (1971) reported only "...9.7 defications per 100 urinations..." (n.p.) and gave possible reasons as (1) constipation due to travel schedule or (2) it is viewed as a more intimate act than urination and they did not want to perform such an act in a public facility (McCall, Gleye, & Singer, 1971). With regard to elimination fixture usage, 79 percent of females used the water closet, while 91 percent of males used either the water closet or urinal (Henning, 1977). The investigator believes this provides some evidence to support the hypothesis that women go to the restroom to perform activities other than that of elimination. For males, one study found that "the most frequent sequence is enter-urinal-exit" (Henning, 1977, p. 2), while another study found that approximately two-thirds of the

participants followed one of these two sequence patterns, (1) enter--urinate--wash--dry--exit (53 out of 153) or (2) enter--urinate--exit (37 out of 153) (McCall, Gleye, & Singer, 1971). For females, "the most common sequence was: enter - WC - wash basin - dry - exit" (Henning, 1977, p. 3). A final interesting concept presented by McCall, Gleye, and Singer (1971) is that the sequencing of events makes it possible for one user to control the speed of another or several other users.

Findings from studies focusing on handwashing have been varied. As previously mentioned, one study found that 39 percent of males did not wash their hands after urination (McCall, Gleye, & Singer, 1971). A study of females found that with an observer present, 18 of 20 washed their hands and without an observer present only 3 of 19 washed their hands. The conclusion was that people wash their hands after using the restroom because of social pressure (Pedersen, Keithly, & Brady, 1986). Another study reported that the location of the wash basins made a difference. If people had to pass a wash basin on their way out, they were more likely to wash their hands (Henning, 1977). In another study males preferred to use paper towels for drying their hands, rather than blow dryers (McCall, Gleye, & Singer, 1971).

Looking at a somewhat different view of public restroom behavior, Middlemist, Knowles, and Matter (1976) found that "...close interpersonal distances increased the delay of onset and decreased the persistance of micturation" (p. 511). This is a physical phenomenon and it is suggested that

> ...if an individual intent on micturating were subjected to a stressor, the onset of micturation would be delayed because of a reduction in the degree of relaxation of the external sphincter, while the duration of urine flow, once begun, would be foreshortened because of increased intravesicle pressure. (Middlemist, Knowles, & Matter, 1976, p. 542)

It appears that, for males, the total time it takes for the urination process (both delay of onset and micturation) is less, the closer together men are at the urinals (see Table 2). Therefore, the investigator believes that when the restroom is very busy and a crowded situation exists, men could actually be taking less time.

A historical perspective on public restroom usage comes from around the early 1920s. The Subcommittee on Plumbing of the Building Code Committee, in their work on minimum plumbing requirements, used the following timing information in order to determine flushing intervals. One set of data came from an office building. It was reported that, on an average, males spent 7.1 minutes in toilet. It was mentioned that separate urinals were present in the

Table 2

Delay and Micturation Time by Interpersonal Distance

Urination Process	Interpersonal Distance		
	Close	Moderate	Control
	(time in seconds)		
Delay of Onset	8.4	6.2	4.9
Micturation	17.4	23.4	24.8
Total	25.8	29.6	29.7

Source: Compiled by the investigator from information in Middlemist, Knowles, and Matter, 1976.

restroom. Another set of data came from a factory. The average time spent in toilet for males was 4.25 minutes and 3.97 minutes for females. The average time for males included the water closet being used as a urinal (U.S. Department of Commerce, 1924, 1929, 1932). Additional information presented was that "the highest number of uses by males was for between 4 and 5 minutes and the highest number of females between 5 and 6 minutes..." (U.S. Department of Commerce, 1924, 1929, 1932, p. 95).

Research indicates that males are indeed faster in their performance of activities in the restroom. Since women are slower, perhaps women's restrooms need a greater number of fixtures/features than do men's restrooms in order to process a comparable number of users through the system during a given period of time.

Special Users

Kira (1966) identified four special user groups which have problems using bathrooms and restrooms. These four groups are: (1) the elderly; (2) the obese; (3) pregnant women; and (4) the handicapped, both physical and mental.

The problems of obese people and pregnant women involve weight, size, and flexibility which makes movement difficult and slow. In addition, pregnant women must go more often, especially "...during the later months of

pregnancy...[with] the ever-increasing pressure on the bladder..." (Kira, 1976, p. 143). Sand, Bowen, and Ostergard (1985) believe a

> ...more plausible explanation for the diurnal frequency is the polydipsia and polyuria of pregnancy. Fluid intake rises rapidly in the first trimester, increasing by 35% and remaining constant until term. Urinary output parallels this increase until the third trimester when a decreased sodium excretion leads to decreased output. (pp. 286-287)

According to Torres, waiting in long restroom lines is especially difficult for both pregnant women and children (Wiegand, 1987).

The problems of the elderly focus mainly on flexibility due to such physical conditions as arthritis and muscular atrophy (Kira, 1966), plus they must also go more frequently (Kira, 1976). Kira (1976) stated that elderly men often experience "...the loss of neuromuscular controls, which in many instances causes old men to be as inept as small boys" (p. 143). Schwartz (1966) reported that constipation was a problem in the group of elderly she studied. Important implications for elderly women is they outnumber men in the population with "...147 women for every 100 men" (Fowles, 1987, p. 1).

The prevalence of severe physical disability appears to differ between males and females, with women "...more

likely to report that they were severely disabled" (U.S. Department of Health and Human Services, 1980, n.p.)

Some multi-handicapped students are not toilet trained prior to being placed in a school setting, and therefore must be trained by their teachers at school. This group is usually considered to be "...severely and profoundly retarded" (Gallender, 1980, p. 28) and in addition, their

> physical limitations usually parallel the intellectual deficit. There may be varying degrees of hearing loss, blindness, paralysis of limbs and limited motor abilities. These students may experience difficulty in manipulating body parts for fine motor tasks in eating or finger dexterity for buttoning and zipping. They will require partial or total assistance in most self-help skills. (Gallender, 1980, p. 278)

Age

To date the only age related literature found has dealt with the elderly and children as restroom users (see previous sections). Though not yet substantiated, the investigator believes that people in different age groups will perform somewhat different activities.

Miscellaneous

The literature has revealed some different ways in which the genders utilize and behave in restrooms and some of these have already been mentioned in previous sections.

In addition, McCall, Gleye, and Singer (1971) reported that males

> ...typically went about their activities in a brisk and business-like manner....Most seemed to spend as little time as possible in the room. That they generally seemed to be in a hurry or that they perhaps found the restroom unpleasant..." (n.p.)

Women behave somewhat differently in that they often go to the restroom in a group, especially when they are in mixed company. Kira (1976) maintains that this behavior is the result of the shame of having to go to the restroom and that women go together in order to protect the identity of the person who really has to go.

Summary and Conclusions

In general, the literature found by the investigator supports the overall composition of the model. In addition, the literature supports the inclusion of the nine user and facility characteristics as variables into the model as factors affecting the service rate.

Past studies have rarely dealt with the topic of public restrooms, focusing instead on space requirements and usage of residential bathrooms (Kira, 1966, 1976; Langford, 1965; Monroe, 1960). To date, the literature has revealed few research studies dealing solely with the topic of public restrooms and each of those found has a

narrow focus. One of these studies addressed only men's restrooms in a major airport (McCall, Gleye, & Singer, 1971); another focused on fixture requirements in office buildings in Great Britain (Davidson & Courtney, 1976); a third reported only on restrooms in an enclosed, suburban shopping plaza in Canada (Henning, 1977); a fourth examined the handwashing practices of females in a university setting (Pedersen, Keithly, & Brady, 1986); a fifth study, at a university campus facility, researched personal space invasions and arousal in males during urinal use (Middlemist, Knowles, & Matter, 1976); a sixth involved determining plumbing fixture requirements for male personnel at military installations (Graus, 1957); a seventh focused on the use of public restroom lounges in large department stores by elderly females (Brent, 1981); while an eighth reported on male homosexual activity in park restrooms (Humphreys, 1975); A ninth study, published in Japanese, concerned restroom facilities in office buildings in Japan (Davidson & Courtney, 1976).

As can be seen there is a paucity of literature, especially research-based literature, directly related to public restroom design and use. Much of the research that has been conducted is fragmented in that (1) it has been conducted in various countries, including Canada, Great Britain, Japan, and the United States; and (2) each study

has had a different and rather narrow focus. In addition, the findings from all of these studies have been somewhat inconsistant (see Table 1). All of this points up the importance of conducting additional research in a more systematic manner.

Hypotheses

The following five hypotheses are listed in both the null and directional forms, because the literature indicates that there is a directional relationship.

Ho1 There is no significant difference between males and females and the average amount of time spent in the restroom.

Ha1 On an average, females spend significantly more time in the restroom than do males.

Ho2 There is no significant difference between males and females and the average number of restroom activities performed per restroom visit.

Ha2 On an average, females perform a significantly greater number of activities per restroom visit than do males.

Ho3 There is no significant relationship between age and the amount of time spent in the restroom.

Ha3 On an average, older people spend significantly more time in the restroom than do people of other age groups.

Ho4 There is no significant difference between males and females and whether or not they have to stand in line to use the restroom.

Ha4 Females have to stand in line significantly more often than do males.

Ho5 There is no significant difference between men's and women's restrooms and the number of users which can be accommodated.

Ha5 Women's restrooms can accommodate fewer users in a given period of time, than can men's restrooms.

The following six hypotheses are listed in the null form only, because the literature does not indicate a directional relationship.

Ho6 For both males and females, there is no significant relationship between the amount of time spent in the restroom and the number of activities performed.

Ho7 For both males and females, there is no significant relationship between age and number of activities performed.

Ho8 For both males and females, there is no significant difference between the types of buildings/facilities and the average amount of time spent in the restroom.

Ho9 For both males and females, there is no significant difference between the types of buildings/facilities and the number of activities performed in the restroom.

Ho10 For both males and females, there is no significant difference between peak and non-peak time and the average amount of time spent in the restroom.

Ho11 For both males and females, there is no significant difference between peak and non-peak time and the average number of activities performed in the restroom.

Chapter 3

METHODOLOGY

The methodology used in this exploratory study is presented in this chapter, and includes (1) development of the instrument, (2) pilot study, (3) criteria for site selection, (4) sample, (5) data collection, (6) survey responses, and (7) data analysis.

Development of the Instruments

A one page questionnaire (see Appendix A), was developed by the investigator. The questionnaire sought the following information: (1) the amount of time the respondent spent in the restroom, (2) the gender of the respondent, (3) the age of the respondent, (4) whether or not the respondent had a mobility handicap, (5) whether it was a peak or nonpeak time at the building/facility, (6) whether it was morning (AM) or afternoon/evening (PM), (7) whether or not the respondent had to stand in line, (8) the amount of time spent in line, (9) the types and number of activities performed by the respondent, (10) the most time-consuming activity performed by the respondent, (11) what the respondent liked most about the restroom, (12) what the respondent thought would improve the restroom, (13) which elimination fixture(s) were used and

(14) the respondent's aggregate of activities performed in the restroom. The questionnaire was color-coded for ease and clarity of data collection and coding; pink for females and blue for males. Each questionnaire was numbered. The timing sheets were also numbered with corresponding numbers.

Pilot Study

A small pilot study was conducted at an on-campus building/facility at Virginia Tech. The duration of the observation period was two hours. This amount of time allowed for many potential problems to arise and be corrected prior to the main study. Items observed during the pilot study included: (1) approximately how many people could be timed and given a questionnaire in an hour; (2) the average number of refusals; (3) any problems with the operation of the stopwatches; (4) the logistics of timing subjects, presenting, and collecting questionnaires; (5) how to present the questionnaires to the subjects; (6) the possible reasons for refusals; (7) the functionality of the two questionnaires and the user demand charts; and (8) people's reaction to the data collectors and the study. Observations made during the pilot study were discussed, investigated, and corrected as necessary.

There were also two data collectors recording the number of people who entered each of the restrooms in fifteen minute intervals and, for the same period of time, those who exited each of the restrooms. Hand-held mechanical counters were used. Each data collector had two mechanical counters, one to record those people entering the particular restroom and one to record those exiting the restroom. At the end of each fifteen minute interval, the counts were transferred to sheets. This type of information was also collected during the larger study and was used to substantiate peak and nonpeak periods.

Criteria for Site Selection

As a result of obtaining information about each of the proposed buildings/facilities, a set of criteria for site selection was formulated by the investigator. The proposed buildings/facilities were then compared against the criteria and evaluated as to suitability for study.

In order to be included in the study, a site had to meet the following criteria:

1. a relatively equal number of male and female users (equal gender distribution is the basis for fixture requirements by the major plumbing codes);

2. a varied population of users;

3. a relatively wide variety of activities that users could perform are possible;

4. two levels of demand in each building/facility, concentrated periods of heavy demand (peak), and continual levels of demand (nonpeak);

5. continual use resulting in at least an average of ten users per hour per restroom;

6. facility located within a reasonable driving distance from Blacksburg, Virginia;

7. data collectors with both visual and physical control over restroom ingress and egress;

8. a manner of operation that requires no more than two data collectors' timing and handing out questionnaires at each male or female restroom at any one time;

9. permission from management to collect data at the buildings/facilities;

10. alcohol consumption not prevalent during periods of data collection;

11. more than one opportunity to collect data at each of the sites;

12. a schedule of appropriate events of similar types at each site during a specified time frame;

13. the cost of the needed amount of data collection not in excess of the research budget;

14. an adequate amount of physical space to accommodate the required number of data collectors, plus their equipment;

15. non-interference with the normal use of the building/facility.

Sample

The following five building/facility types were originally proposed for the sample:

- Airport
- Highway Rest Area
- Sports Arena
- Conference Center
- Theater/Auditorium

For the five aforementioned site types, specific buildings/facilities in the area were proposed for use in the study. The following is a brief overview of the sites, the reasons for their selection, and their evaluations as to suitability for study.

Airport. The originally proposed airport (Airport A) was selected because, as one of the hubs of a major airline, it was one of the closest airports which is continually busy, ensuring that the restrooms would have a continual level of use, as well as peak times of use. Also the design of the airport is such that each restroom services approximately nine to ten continually busy gates.

Airport A, however, was not within a reasonable driving distance, and in addition, data collectors would not have had visual or physical control over restroom ingress and egress, due to each restroom having two doors located far apart. Therefore a second airport (Airport B) was selected. Airport B, though somewhat small and not as busy as Airport A, is considered to be a regional airport. It is also within close proximity to the researchers. And, because the airport had only one restroom for public use for each gender, these restrooms received considerable use. In addition, the restrooms were located down a hall in a sheltered area of the airport, thus ensuring both visual and physical control over restroom ingress and egress, and had only one door each.

Highway Rest Area. The rest area was selected because it is a busy rest area on a major north/south highway serving a varied population due to the large number of tourists. The rest area also has a manned welcome station, open from 8 AM to 5 PM, seven days a week, which perhaps could have lent some support to the research project if people questioned the legitimacy of the project. The employees reported that they received no questions, comments, or complaints from users of the facility.

Sports Arena. The originally proposed sports facility was the football stadium on the Virginia Tech campus. Permission was requested for the first three home games of the season. Permission, however, was obtained for only one football game--the last one of the season, thus failing to meet the established criteria of more than one opportunity to collect data. The risk factor associated with this site was that if sufficient data were not collected, there would be no second chance to collect additional data at the site. The stadium also did not meet the following criteria: (1) data collectors would not have either visual or physical control over restroom ingress or egress, since there are two doors to each restroom, with users having the option of entering and/or exiting from either door, and in addition, the distance between the doors was so great that it would not have allowed the data collectors to stand halfway between the doors and still be able to track the person they were timing; and (2) in order to collect a sufficient amount of data, at least three data collectors would have been needed for each restroom. Also it was suggested that the consumption of alcoholic beverages prior to and during the games would present a problem. By the time it was decided not to conduct the survey at the football stadium, basketball season had begun. Permission was sought and granted for

the first three basketball games after the beginning of the calender year. The basketball coliseum met all of the established criteria and proved to be an optimal data collection site. And, unlike the football stadium, (1) alcohol consumption was not a problem; (2) two data collectors at each restroom were sufficient; (3) there were multiple opportunities to collect data; and (4) even though each restroom had two doors, they were close enough together to allow the data collectors to have both visual and physical control over restroom ingress and egress.

Conference Center. The proposed conference facility was selected for its high level of use, wide variety of conferences, and its campus location. In addition, this site met all of the established criteria, including (1) both visual and physical control over restroom ingress and egress by the data collectors, (2) an adequate amount of physical space to accommodate the required number of data collectors, plus their equipment, and (3) a sufficient number of restroom users. Permission was sought to collect data at three conferences and after a long delay, permission was finally granted for the collection of data at one conference.

Theater/Auditorium. A large auditorium (Auditorium A), located on campus, was selected as the original site. A check on the number and types of activities scheduled for this facility showed a lack of appropriate activities of a similar type within a specified time frame. A second auditorium (Auditorium B) was then selected. There were five theater performances (one each night for five nights) scheduled at this facility. Permission was then obtained for surveying the users of the facility. It was later discovered that the facility did not meet the following criteria: (1) there was no continual level of use of the restrooms, there was only a limited peak use of one ten minute intermission per performance; (2) at least ten data collectors per restroom would have been needed each of the five nights in order to collect the data (there were actually only four nights available for data collection, since one night was devoted to high school students--minors); and (3) the cost of data collection would have been prohibitive. Failure of this site to meet the established criteria, resulted in it being dropped from the study.

It was then decided to use the following four buildings/facilities in the study:

- Airport
- Highway Rest Area
- Sports Arena
- Conference Center

For each of the buildings/facilities, one public restroom of heaviest use (one each for males and females) was determined and selected for use in the study. For the airport, highway rest area, and conference center there was only one each for males and females (public use). There were employee restrooms, but these were not considered. For the sports arena, there were three sets of restrooms (a set includes one male and one female restroom), plus one additional male restroom with no female counterpart.

Data Collection

First, each of the four buildings/facilities was determined by the investigator to have both periods of continual level of demand (nonpeak) and concentrated periods of heavy demand (peak), throughout the day. The

airport had approximately an hour of peak usage time both in the morning and the afternoon. The peak times were those when multiple flights were scheduled to take off. The highway rest area also had approximately an hour of peak usage time both in the morning and afternoon. The sports arena had heavy use prior to the start of the game, continual use throughout the game, with peak usage being the 20 minutes of half-time. At the conference center, the heaviest periods of use were during breaks, and before and after lunch. Each building/facility was observed on the most active days during a week, as determined by the investigator, based on interviews with the appropriate people associated with the management of the building/ facility.

It was difficult to estimate, prior to the study, male/female usage of the restrooms or the percentage of those who would participate in the study. An effort was made to observe males and females in both the morning and afternoon/evening at the airport, highway rest area, and conference center, as well as in peak and nonpeak times (see Table 3). Basketball games were held only in the afternoons and evenings. These data collection times were determined on the basis of trying to obtain information on the most varied number of activity types possible, because the types of activities performed were thought to be

Table 3

Time of Day Male and Female Respondents and Nonrespondents Used the Restrooms at the Four Sites

Time of Day	Airport				Rest Area				Sports Arena				Conference Center			
	Males		Females		Males		Females		Males		Females		Males		Females	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Respondents	(N = 57)		(N = 55)		(N = 56)		(N = 58)		(N = 54)		(N = 58)		(N = 63)		(N = 53)	
Morning (AM)	8	14.0	34	61.8	28	50.0	13	22.4	-	--**	-	--**	27	42.9	24	45.3
Afternoon/Evening (PM)	49	86.0	21	38.2	28	50.0	45	77.6	54	100.0	58	100.0	36	57.1	29	54.7
Total	57	100.0	55	100.0	56	100.0	58	100.0	54	100.0	58	100.0	63	100.0	53	100.0
Peak	20	35.1	19	34.5	33	58.9	25	43.1	23	42.6	14	24.1	7	11.1	3	5.7
Nonpeak	37	64.9	36	65.5	23	41.1	33	56.9	31	57.4	44	75.9	56	88.9	50	94.3
Total	57	100.0	55	100.0	56	100.0	58	100.0	54	100.0	58	100.0	63	100.0	53	100.0
Nonrespondents*	(N = 56)		(N = 44)		(N = 19)		(N = 34)		(N = 34)		(N = 32)		(N = 13)		(N = 6)	
Morning (AM)	18	32.1	22	50.0	9	47.4	12	35.3	-	--**	-	--**	10	76.9	2	33.3
Afternoon/Evening (PM)	38	67.9	22	50.0	10	52.6	22	64.7	34	100.0	32	100.0	3	23.1	4	66.7
Total	56	100.0	44	100.0	19	100.0	34	100.0	34	100.0	32	100.0	13	100.0	6	100.0
Peak	25	44.6	21	47.7	8	42.1	18	52.9	14	41.2	3	9.4	0	0.0	0	0.0
Nonpeak	31	55.4	23	52.3	11	57.9	16	47.1	20	58.8	29	90.6	13	100.0	6	100.0
Total	56	100.0	44	100.0	19	100.0	34	100.0	34	100.0	32	100.0	13	100.0	6	100.0

*Defined as those subjects who were timed, but refused to complete the questionnaire.
**Questionnaires administered during the afternoon/evening only.

influenced by the time of day and whether or not the restrooms were busy. This amount of observation time allowed for behavioral patterns to emerge. For the sports arena, data were collected for the time period of the entire event, plus an amount of time both before and after the event.

Scaled floor plans, denoting the location of all fixtures and features of each restroom, were obtained for each building/facility. An inventory of fixtures and features was also taken for each restroom. Plans were redrawn from original floor plans incorporating modifications observed during inventory.

A coordinator was present to oversee the data collection process, answer questions, replenish clipboards with questionnaires, and to see that the completed questionnaires were properly placed in the collection box. Elements at the site which explained the study and identified it as being affiliated with Virginia Tech included: (1) a sign bearing the study title and Virginia Tech seal; (2) a collection box with the study title placed directly on it; (3) name tags for the data collectors and coordinator; (4) a letter of explanation of the study, from the head of the Department of Housing, Interior Design, and Resource Management, prominantly displayed near the questionnaire collection box; (5) a

notebook containing letters of permission, in case anyone wanted to see them (no one did); and (6) a clipboard with a sign-up sheet for people wanting a copy of the results of the study.

A systematic random sample selection procedure was carried out to the best of the data collectors' ability given the existing conditions under which they had to work. Prior to, or immediately before, each data collection session, a table of random numbers was used to determine the person between one and four to be surveyed. The appointed data collectors selected the nth person entering each of the restrooms and began timing this person, using a stopwatch. Each data collector had only one stopwatch and thus timed only one person at a time. The observation time ended when the person exited the restroom, at which time the data collector stopped the stopwatch, approached the person and asked if he or she would complete a brief questionnaire. Questionnaires were presented to the subjects on a clipboard with an attached pen. Their time spent in the restroom was recorded on a separate sheet and transferred to the questionnaire at a later time. Times were kept separately due to the limited amount of time available to contact the participant and to avoid participant confusion. After the questionnaire had been presented and explained to the individual, the data

collector waited until the next nth person went into the restroom and then began timing this person. This process continued until termination of the observation period. Any hesitation or refusals by the subjects was accepted graciously. Information pertaining to refusals were recorded by gender of nonrespondents. Nonrespondents were defined as those subjects who were timed, but refused to complete the questionnaire.

An exception to this methodological plan concerns the exclusion of minors from the study. The population of this study was limited to adults, defined as 18 years of age and older. The data collectors made judgements as to whether the next person to be timed was 18 years of age or older. If the person was judged to be an adult, then the data collector followed the procedure outlined above. If the person was judged to be under age 18, the next adult was selected for inclusion in the study. If there was any question as to whether the person being timed was under 18, the person was asked if he or she were 18 years of age or older before being asked to complete a questionnaire. If the person was under 18, a questionnaire was not presented.

Survey Responses

Based on the statistical tests selected for testing the hypotheses, and the recommendation of the statistician, a sample of approximately 50 persons of each gender at each site was needed. The decision was made to collect data at each site until the needed number of questionnaires was obtained. A few additional questionnaires, over the required 50, were collected in order to allow for improperly completed or incomplete questionnaires. Very few questionnaires were omitted. The resulting sample for each site and each gender, was approximately equal in number (see Table 4).

The percentage of nonrespondents varied by site. Various reasons were given for refusing to complete the questionnaire (see Table 5). At the airport, approximately two-thirds of both male and female nonrespondents gave "lack of time" as the reason for refusing to complete the questionnaire. No reason was given by one-fifth of the females and approximately 15 percent of the males. Other reasons for male refusals were, ignored the data collector (3); didn't have his glasses; and not a native. Reasons for female refusals included, ignored the data collector (2); foreign--difficulty with English (2); busy with a handicapped person; and too tired. A small percentage of

Table 4

Survey Response

Questionnaires	Males n	Males %	Females n	Females %
Airport	(N = 116)		(N = 103)	
Usable questionnaires	57	49.1	55	53.4
Unusable questionnaires				
Refused	56	48.3	54	42.7
Omitted*	3	2.6	4	3.9
Total	116	100.0	103	100.0
Rest Area	(N = 80)		(N = 93)	
Usable questionnaires	56	70.0	58	62.4
Unusable questionnaires				
Refused	19	23.7	34	36.6
Omitted*	5	6.3	1	1.0
Total	80	100.0	93	100.0
Sports Arena	(N = 91)		(N = 94)	
Usable questionnaires	54	59.3	58	61.7
Unusable questionnaires				
Refused	34	37.4	32	34.0
Omitted*	3	3.3	4	4.3
Total	91	100.0	94	100.0
Conference Center	(N = 77)		(N = 60)	
Usable questionnaires	63	81.8	53	88.3
Unusable questionnaires				
Refused	13	16.9	6	10.0
Omitted*	1	1.3	1	1.7
Total	77	100.0	60	100.0

*Questionnaires were omitted for the following reasons: subject was a minor, subject took an inordinate amount of time, no time recorded, questionnaire incomplete or inappropriately completed.

Table 5

Reasons Given for Refusing to Complete the Questionnaire

Reasons	Males n	Males %	Females n	Females %
Airport	(N = 56)		(N = 44)	
Lack of time	38	67.9	27	61.4
Other reason	5	8.9	6	13.6
No reason given	8	14.3	9	20.5
Missed*	5	8.9	2	4.5
Total	56	100.0	44	100.0
Rest Area	(N = 19)		(N = 34)	
Lack of time	10	52.6	19	55.9
Other reason	2	10.5	6	17.6
No reason given	4	21.1	7	20.6
Missed*	3	15.8	2	5.9
Total	19	100.0	34	100.0
Sports Arena	(N = 34)		(N = 32)	
Lack of time	5	14.7	17	53.1
Other reason	5	14.7	11	34.4
No reason given	23	67.6	4	12.5
Missed*	1	2.9	0	0.0
Total	34	100.0	32	100.0
Conference Center	(N = 13)		(N = 6)	
Lack of time	11	84.6	4	66.7
Other reason	1	7.7	1	16.7
No reason given	1	7.7	1	16.7
Missed*	0	0.0	0	0.0
Total	13	100.0	6	100.0

*Defined as those people moving so quickly that the data collectors could not make visual, physical, or vocal contact with them in order to ask them to complete the questionnaire.

the people were "missed," because they were moving so quickly that the data collectors could not make visual, physical, or vocal contact with them in order to ask them to complete the questionnaire. These were counted as refusals.

Lack of time was the major reason given for refusals at the rest area for both males (52.6%) and females (55.9%). About one-fifth of each gender gave no reason for refusing. The two other reasons given by males for refusal were, no glasses and someone was waiting on him. Reasons given by females for refusing to complete the questionnaire were, no glasses (2); elderly; headache; too hard; and husband waiting. Only a small percentage of both males and females were missed.

At the sports arena, reasons for refusing to complete the questionnaire were similar to those for the other three sites. Lack of time was the primary reason given by females (51.1%). The majority of males (67.6%), however, gave no reason for their refusals. This could reflect their eagerness to return to the basketball game, thus being in reality, a lack of time to complete the questionnaire. Other reasons given by males for refusing included, can't see without glasses (2); busy (2); and very dirty. For females, other reasons given for refusing included, no glasses/can't see (4); have to meet/find

someone/husband (3); already completed a questionnaire (2); ignored the data collector; and can't read English. No females and only a small percentage of males were missed.

At the conference center, both males and females gave lack of time as the main reason for refusing to complete the questionnaire. With regard to other reasons given for refusing, one male ignored the data collector, while a female refused because she was leaving. Only a small percentage of both males and females gave no reason for refusing. No one was missed.

Data Analyses

Data from the questionnaire were coded, transferred to op scan sheets, a data file was created, and checked for accuracy. The Statistical Package for the Social Sciences (SPSSx) was used for both the descriptive and statistical analyses of the data. The descriptive analysis consists of frequencies and percentages. Pearson product-moment correlation, t-tests, comparison of ratios, one-way analysis of variance, and a test of equal proportion were used to analyze partial data from the questionnaire in order to test the 11 null and five alternate hypotheses. A predetermined .05 level of significance was used throughout

the study for the rejection of the null and alternate hypotheses.

Hypotheses Testing

Ho1 and Ha1. A t-test was used to test whether the difference in the mean time spent in the restroom by males and females (two independent, random samples) was significant. A one-tailed test was selected because of the directional alternate hypothesis. Four such t-tests were conducted, one for each site.

Ho2 and Ha2. A t-test was used to test whether the difference in the mean number of activities performed in the restroom by males and females (two independent, random samples) was significant. A one-tailed test was selected because of the directional alternate hypothsis. Four such t-tests were conducted, one for each site.

Ho3 and Ha3. A Pearson product-moment correlation was used to test whether there was a significant relationship between age and the amount of time spent in the restroom. A one-tailed test was selected because of the directional alternate hypothesis. In addition, a

scattergram was plotted to determine the type of relationship, whether it was positive, negative, or zero (see Appendix B). Both of these procedures were carried out for each gender at each site.

Ho4 and Ha4. A test of equal proportion was used to test whether the difference between males and females and whether or not they had to stand in line to use the restroom, was significant. Only peak times were examined, since this is when most waiting lines would form. Four such tests were conducted, one for each site.

Ho5 and Ha5. A comparison of the ratio of the mean amount of time spent in the restroom by males and females (respondents and nonrespondents), during nonpeak periods, to the ratio of the number of elimination fixtures in the male and female restrooms, was used to examine the difference between men's and women's restrooms and the number of users which can be accommodated. This was carried out for each of the four sites.

Ho6. A Pearson product-moment correlation was used to test whether there was a significant relationship between the the number of activities performed and the

amount of time spent in the restroom. A two-tailed test was selected since there was no directional alternate hypothsis. In addition, a scattergram was plotted to determine the type of relationship, whether it was positive, negative, or zero (see Appendix B). Both of these procedures were carried out for each gender at each site.

Ho7. A Pearson product-moment correlation was used to test whether there was a significant relationship between age and number of activities performed. A two-tailed test was selected, since there was no alternate hypothesis. In addition, a scattergram was plotted to determine the type of relationship, whether it was positive, negative, or zero (see Appendix B). Both of these procedures were carried out for each gender at each site.

Ho8. A one-way analysis of variance was used to test whether there was a significant difference between the four types of buildings/facilities and the average amount of time spent in the restroom by males and females. This procedure was carried out separately for each gender. If there was a significant difference, as determined by the F-statistic, then the Duncan multiple comparison procedure

was used to pinpoint which buildings/facilities were different from each other.

Ho9. A one-way analysis of variance was used to test whether there was a significant difference between the four types of buildings/facilities and the average number of activities performed in the restroom by males and females. This procedure was carried out separately for each gender. If there was a significant difference, as determined by the F-statistic, then the Duncan multiple comparison procedure was used to pinpoint which buildings/facilities were different from each other.

Ho10. A t-test was used to test whether the difference between peak and nonpeak time at the building/facility (two independent, random samples) and the average amount of time spent in the restroom by both males and females, was significant. A two-tailed test was selected since there was no directional alternate hypothesis. Eight such tests were conducted, one for each gender at each site.

Ho11. A t-test was used to test whether the difference between peak and nonpeak time at the building/facility (two independent, random samples) and the

average number of activities performed in the restroom by both males and females, was significant. A two-tailed test was selected since there was no directional alternate hypothesis. Eight such tests were conducted, one for each gender at each site.

CHAPTER 4

BACKGROUND INFORMATION PERTAINING TO THE STUDY

This chapter provides background information pertaining to the study, thus facilitating a better understanding of the study. The chapter is divided into four sections, the first of which contains background information on codes and standards. The second section focuses on the current code requirements for the four types of sites in the study. The third section gives a description of the restrooms in the study, followed by a brief discussion of how well these restrooms meet existing plumbing codes.

Background Information on Codes and Standards

Architectural Graphic Standards, originally compiled by Ramsey and Sleeper and currently edited by Packard (1983) and affiliated with the American Institute of Architects (AIA), serves as a reference guide or "bible" for those in various design and building professions, such as architects, interior designers, engineers, draftsmen, and builders (AIA, 1970). To date, there have been seven editions of the book (1932, 1936, 1941, 1951, 1956, 1970, 1983). The first (1932), second (1936), and third (1941) editions do not include plumbing fixture requirements.

Plumbing fixture requirements first appeared in the fourth edition (1951). The source of these requirements was given as "Plumbing Code" A.S.A. A40.7-1949, the American Society of Mechanical Engineers in both the fourth (1951) and fifth (1956) editions. The 1949 date of the code could explain why plumbing fixture requirements first made their appearance in the fourth (1951) edition. From the fourth edition (1951) until the sixth edition (1970), there appeared to be little or no change in the number of plumbing fixtures required. The plumbing fixture requirements were expanded in the category "places of assembly," in the seventh and latest edition (1983), though not in the direction the literature would indicate. The number of urinals required was actually increased. It was difficult to compare other building/facility type categories, as the categories had been changed somewhat from the previous edition (1970). A change in the source of information from the "Plumbing Code" A.S.A. A40.7-1949 to the New York State General Construction Code and Multiple Dwelling Code (Packard, 1983) could possibly account for these changes.

According to Miller (1960), plumbing codes were discussed in the early 1920s, continued to be discussed and acted upon into the 1930s and 40s, and again gained attention in the 1950s. The early code discussions of the

1920s and 30s (U.S. Department of Commerce, 1924, 1929, 1932) focused primarily on such topics as the physics of a plumbing system, supplying water to the system, drainage systems, inspections, installations, materials, and the industry. In addition, these codes were residential in scope, but later reports stated that "the basic principles of the former report are retained, but their application is extended to all types of buildings" (U.S. Department of Commerce, 1929, p. ii; 1932, p. ii). Still, in these three reports, no mention was made of the number of plumbing fixtures required for public restrooms. Nugey, however, published a book in 1928 entitled Plumbing Design, which was considered by the author to be a comprehensive treatment of the subject of plumbing. This appears to be one of the earliest references to plumbing fixture requirements for nonresidential buildings/facilities. Only three categories were listed--hotels, schools, and industrial plants and office buildings. His recommendations for fixtures were as follows: in a hotel, one lavatory was required for every seven persons; in a school, one for every nine persons; and in an industrial plant or office building, one for every 10 persons. With respect to urinals in hotels, one was required for every 19 persons; in a school, one for every 23 persons; and in an industrial plant or office building, one for every 25

persons. Water closets were specified as one for every 12 persons in a hotel; one for every 14 persons in a school; and one for every 12 persons in an industrial plant or office building. No mention was made of how Nugey arrived at these requirements. From these early fixture requirements of the 1920s, it appears that males would have more elimination fixtures in their restrooms than females, assuming that males would have urinals and females would not. Nugey (1928), presents in Chapter XXXVII of his book Plumbing Design, entitled "Plumbing Rules of the City of New York", minimum fixture requirements, among other things. These rules had been adopted in 1924 by the Board of Standards and Appeals. As can be seen, these rules appear to be very general and apply to a myriad of building and facility types. The following is an excerpt from the rules--

> In all buildings occupied as stores, dwellings, lodging or boarding houses, hotels, offices, lofts work-shops, factories, or storage houses, there must be at least one water-closet in each building. There must be sufficient water-closets so that there will never be more than 15 persons to each water-closet. In places of assembly, the number of toilets and the most available location are to be determined by the Superintendent of Buildings. (Nugey, 1928, p. 330)

The focus of the codes of the 1940s was still primarily residential in nature (Standards for Sanitation, 1940), although, as mentioned earlier, in the late 1940s,

"Plumbing Code" A.S.A. A40.7-1949, appears to have stated plumbing fixture requirements for public restrooms in various building/facility types (Ramsey & Sleeper, 1951, 1956). The third oldest minimum fixture requirements for nonresidential buildings/facilities found by the investigator, to date, were located in the 1951 Report of the Coordinating Committee for a National Plumbing Code. They are similar to those existing today, but are not as extensive with regard to types of buildings and facilities. To give an example, for a theater or auditorium which holds 300 people, females would have been entitled to three water closets, while males would have been entitled to three water closets, plus two urinals. It should be noted that this was not necessarily the case for all buildings/ facilities.

Elimination Fixtures Required by Code

The Commonwealth of Virginia follows the Building Officials & Code Administrators (BOCA) National Plumbing Code. The latest edition of which is 1987. Minimum elimination fixture requirements for three of the four types of sites--airport, rest area, and conference center are specified in the BOCA Code (see Table 6). The minimum fixture requirements for rest areas are specified by the

Table 6

Minimum Number of Elimination Fixtures Currently Required by Code for Each of the Four Types of Sites

Site	Code Requirements			
	Number of People	Male WCs	Male Urinals	Female WCs
Airport	125	1	*	1
Rest Area	0-125	2	2	4
	105-225	3	3	6
	225-315	4	4	9
	315-375	5	4	10
	375-435	7	4	12
	435-500	9	5	14
Sports Arena	125	1	*	1
Conference Center	125	1	*	1

Source of information:
Airport--BOCA (1987), Building use group A-3 (Halls, museums, etc.)
Rest Area--Bureau of Public Roads, Preliminary Design Guide for Rural Interstate Safety Rest Areas, with Comfort Stations (1969)
Sports Arena--BOCA (1987), Building use group A-5 (Assembly, stadiums, pools, etc.)
Conference Center---BOCA (1987), Building use group A-3 (Halls, museums, etc.)

*Urinals may not be substituted for more than half (50%) of the required water closets.

Note: BOCA Code is based on a 50% gender distribution.

Bureau of Public Roads. These requirements were last revised in 1969. The BOCA Code specifies only water closets and these specifications are the same for males and females. The designer has the option of substituting urinals for water closets, but no more than 50% of the water closets may be replaced with urinals. The designer may specify above the minimum if addition urinals are desired. This may lead to the greater number of elimination fixtures often found in male restrooms. For rest areas, in the two lowest user categories, males and females have an identical number of elimination fixtures specified. In the next three user categories, females have one more elimination fixture than males. In the last user category, the required elimination fixtures return to being equal for males and females. From the minimum requirements of the codes, elimination fixture specifications appear to be fairly equal. Perhaps it is the judgement of the restroom designer which leads to more elimination fixtures being specified for men's restrooms than for women's restrooms.

Description of the Restrooms

The following is a brief description of the male and female restrooms in the study. Also included are

floorplans of each of the restrooms (see Figures 5, 6, 7, and 8)

At all four sites, the number of water closets for females either met or exceeded the number of water closets for males (see Table 7). But, with the additional urinals for males at two of the four sites, airport and conference center, males had a greater total number of elimination fixtures than females. At the rest area, there were an equal number of elimination fixtures for males and females. At the sports arena, females had one additional elimination fixture than did males. This may be somewhat misleading in that eight of the 16 elimination fixtures were female urinals which are not as easily used as water closets and are often avoided by females.

For each site, males and females had an equal number of toilet tissue holders per stall. Paper seat covers were found only at one site, the airport. But, they were available for both males and females. Disposal containers for feminine hygiene products were in women's restrooms at three of the four sites--airport, rest area, and conference center. Some of the stalls in both male and female restrooms, at all four sites, had hooks. There was a problem, however, with missing hooks. Shelves in the stalls were uncommon. There were a relatively equal number

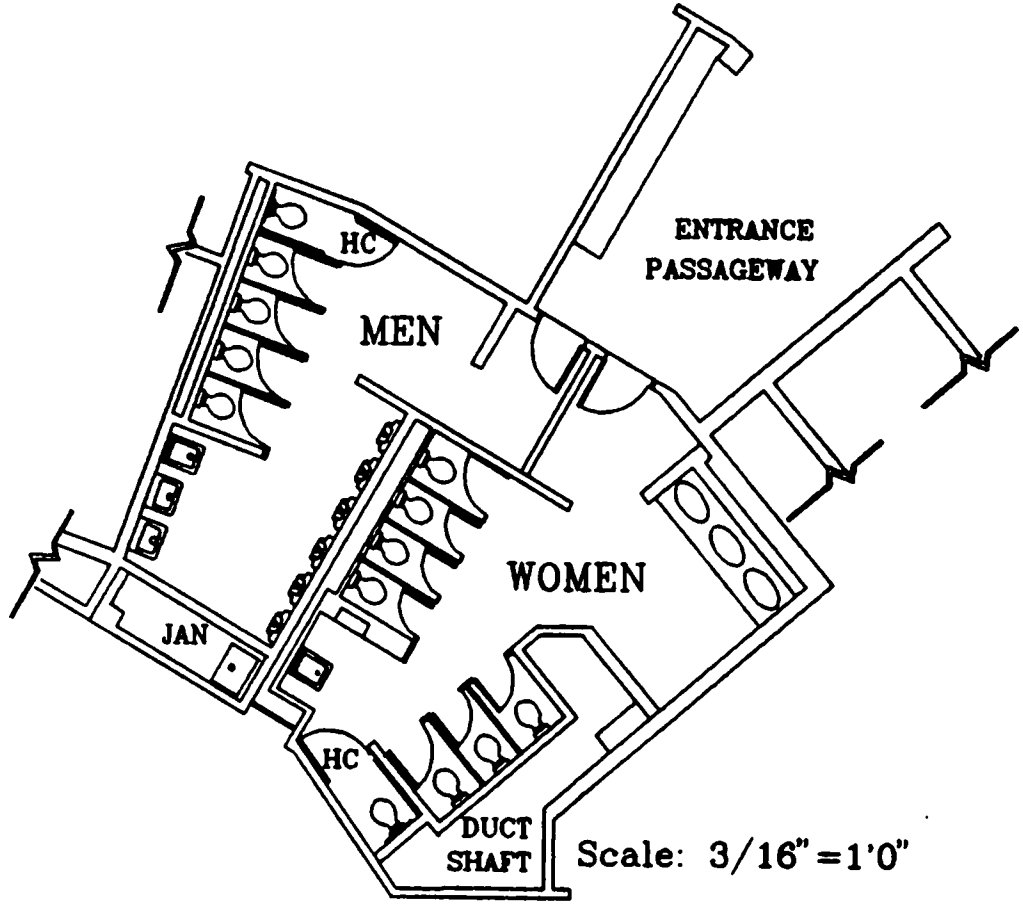


FIGURE 5. Airport Restrooms

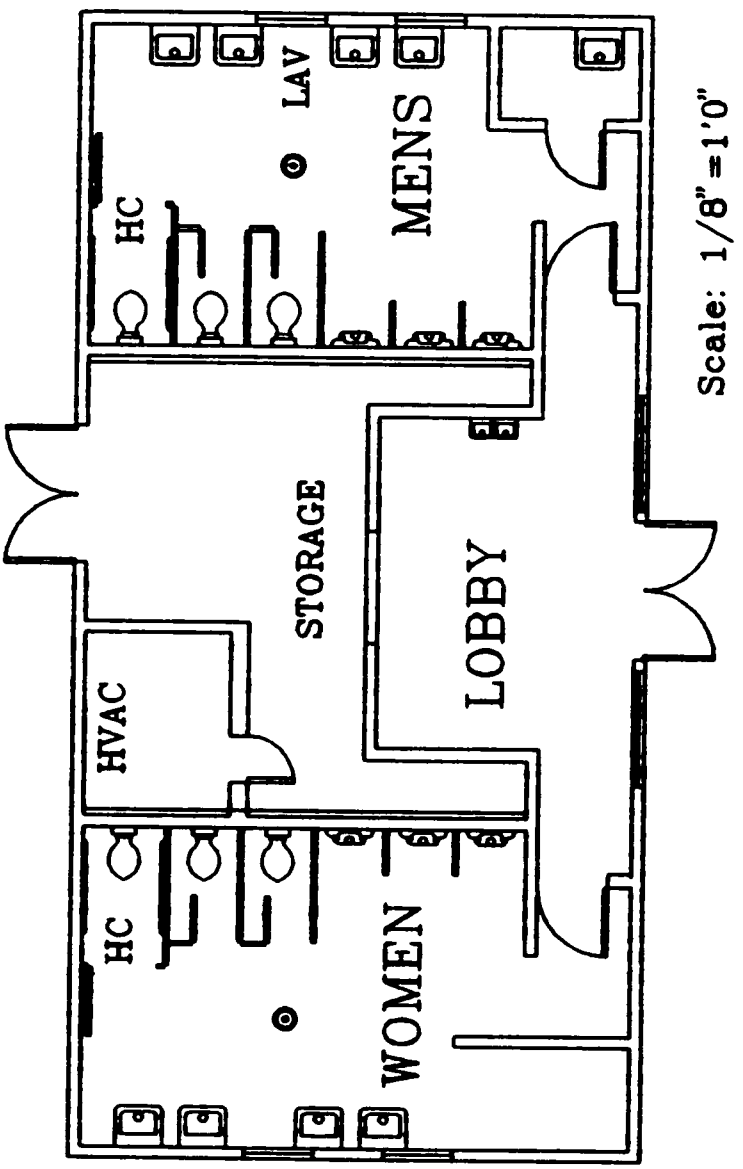


FIGURE 6. Rest Area Restrooms

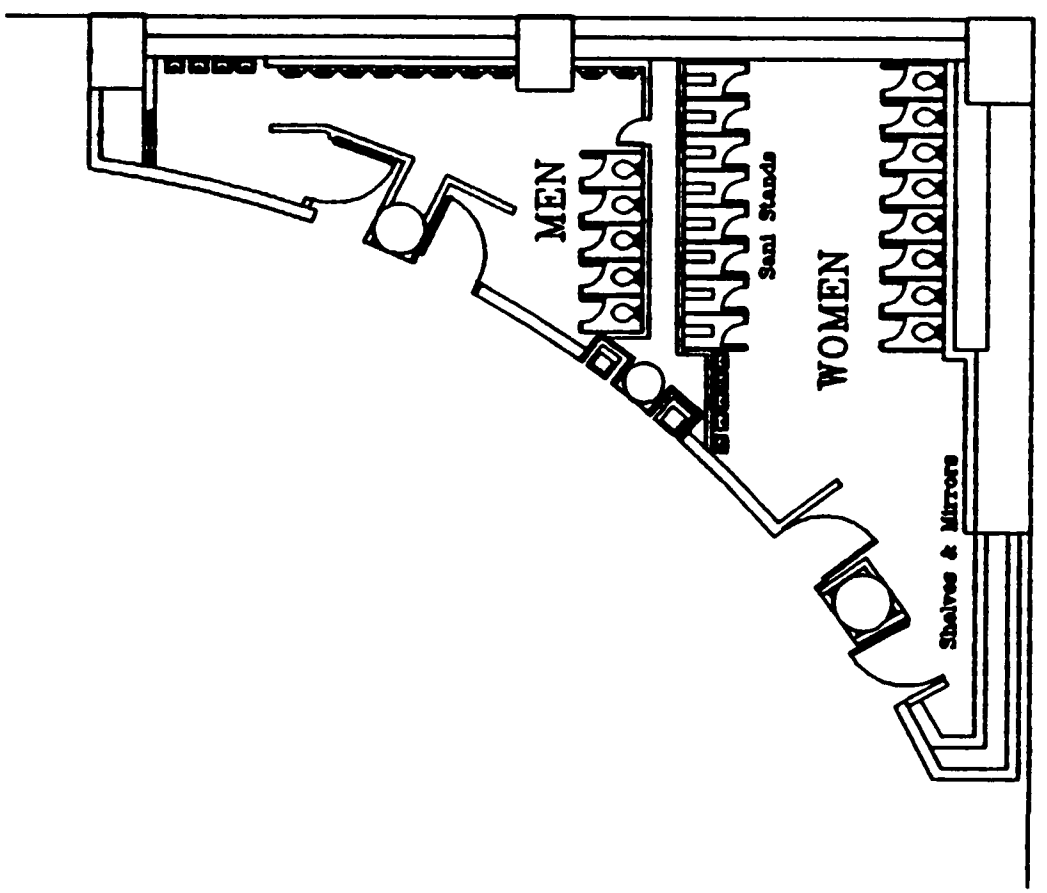


FIGURE 7. Sports Arena Restrooms

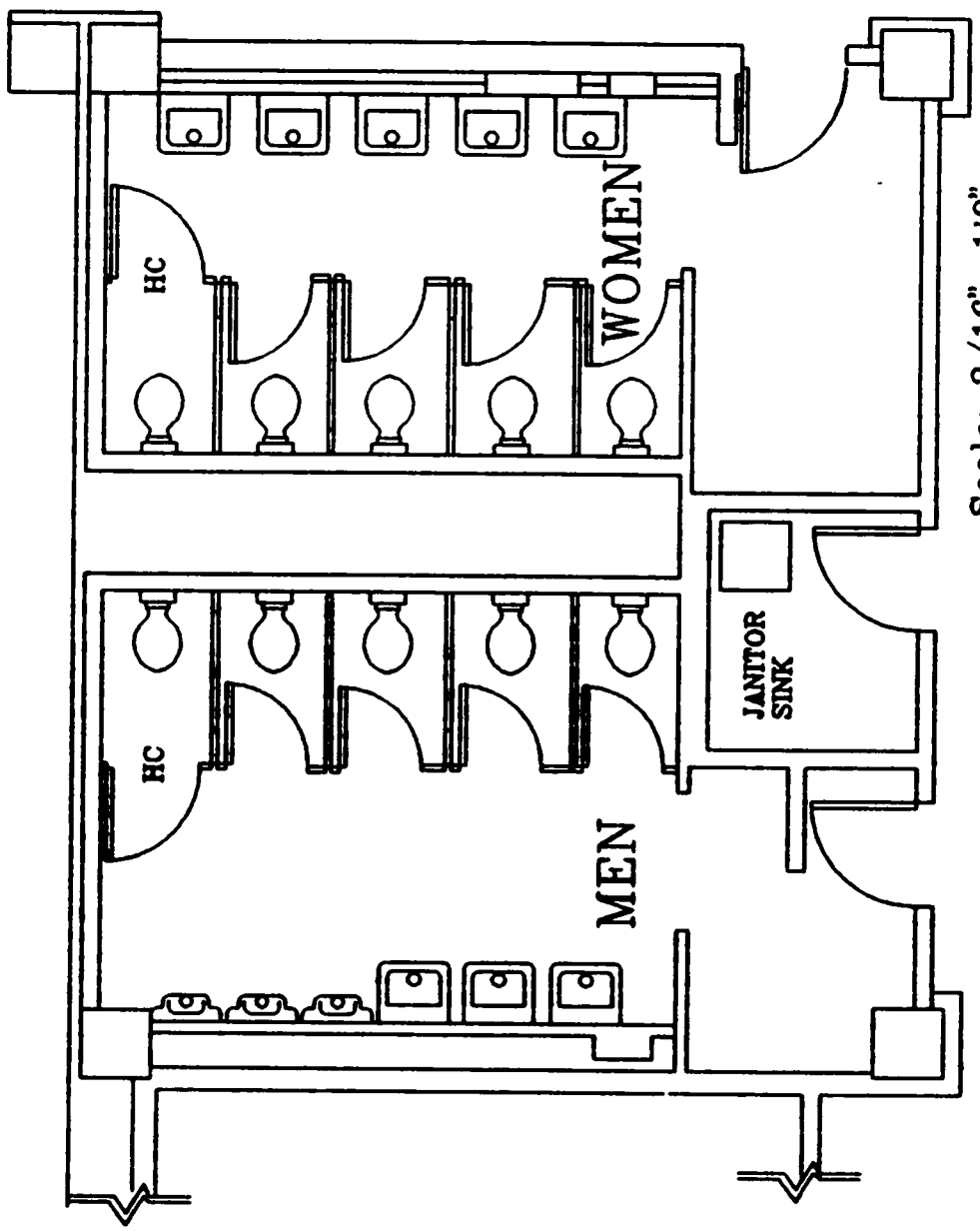


FIGURE 8. Conference Center Restrooms

Table 7

Inventory of Male and Female Restroom Fixtures and Features

Site	W/C: ( ) = handicapped	Urinals: ( ) = handicapped	Toilet tissue holders per stall	Seat cover dispensers	Disposal containers for feminine hygiene products	Stalls currently having hooks/ ( ) = had hooks originally, but are now missing	Shelf in stall	Sinks	Mirrors	Soap dispensers	Air dryer	Paper towel dispensers	Cloth roller towel dispensers	TOTAL ELIMINATION FIXTURES
Airport														
Male	5(1)	6(0)	2	5	NA	3(2)	5	5	5	5	2	5	0	11
Female	8(1)	NA	2	8	8	7(1)	0	4	4	3	1	5	0	8
Highway Rest Area														
Male	3(1)	3(0)	1	0	NA	0(2)	0	4	4	4	1	3	0	6
Female	6(1)	NA	1	0	6	5(1)	6	4	5	4	1	3	0	6
Sports Arena														
Male	5(0)	10(0)	1	0	NA	3(2)	0	4	0	2	0	2	0	15
Female	8(0)	8(0)	1	0	0	16	0	5	4	3	0	2	0	16
Conference Center														
Male	5(1)	3(0)	2	0	NA	5	0	3	3	2	0	2	0	8
Female	5(1)	NA	2	0	5	4(1)	0	5	5	4	0	3	0	5

of sinks and mirrors for both males and females at each of the four sites. The exception was the male restroom at the sports arena, which had no mirrors. Soap dispensers and paper towel dispensers were relatively equal in number for both males and females at all four sites. Only two sites, airport and rest area, had air dryers for hands, while none of the restrooms had cloth roller towel dispensers.

Discussion

Since these buildings/facilities were probably constructed prior to the enactment of the current plumbing codes, only elimination fixture ratios will be discussed. At two of the sites--airport and conference center, male elimination fixtures exceeded those for females. These excess elimination fixtures are not required by the current BOCA plumbing code. They may have been required by an earlier code or were specified at the discretion of the designer. The rest area restrooms had an equal number of elimination fixtures for males and females, thus conforming to code, with respect to three of the six user categories. It was constructed under the current plumbing code used by the Bureau of Public Roads. Looking at ratios, the elimination fixtures for the women's restroom at the sports arena exceed the curent code, with females having one more

elimination fixture than males. The restrooms in the study, when looking at elimination fixtures ratios, appear to meet or exceed the current codes.

Chapter 5

RESULTS AND DISCUSSION

The first section of this chapter contains the descriptive analyses of the data including: information on the number and types of activities performed in the restroom by males and females; restroom use patterns; the most time-consuming activities; the amount of time spent in the restroom, whether or not they stood in line, and for how long; the fixtures used; the most liked fixtures and features of the restroom; suggestions for improvement, and age of the restroom users. This is followed by a summary and discussion of the findings. Presented in the second section of this chapter are the statisticsl analyses of the data and examination of the hypotheses. These are followed by a summary and discussion of the findings.

Descriptive Analyses

Number of Activities

The questionnaires listed a wide range of possible restroom activities, 18 for males and 22 for females. In addition, on each questionnaire, there were two spaces marked "other" for the respondents to write in any activities they had performed, but which were not listed as

a choice. Even with such a large number of possible activities, a majority of both male (70.2%) and female (65.5%) respondents at the airport reported performing no more than five activities (see Table 8). Males performed no more than six activities, while females performed no more than nine. Only a small percentage of both males (7.0%) and females (3.6%) performed only one activity. For males, the most often sole activity performed was urination. For females, the most often performed sole activity was split between urination and checking appearance.

At the rest area restrooms, one-fifth of the male respondents reported performimg only two activities, these were most often urination and washing hands. A slightly lower percentage of females (15.5%) reported performing only two activities, usually urination and washing hands. Again the majority of both males (64.2%) and females (70.7%) reported performing only three to five activities. No male reported performing more than six activities, while no female reported more than eight. Only a small percentage of males (3.6%) reported performing one activity, which was urination, while no females reported only one activity.

At the sports arena restroom, one-fifth of the males reported performing only the activity of urination. In

Table 8

Total Number of Activities Performed in the Restroom by Male and Female Respondents at the Four Restroom Sites

Number of Activities	Airport				Rest Area				Sports Arena				Conference Center			
	Males		Females		Males		Females		Males		Females		Males		Females	
	n (N = 57)	%	n (N = 55)	%	n (N = 56)	%	n (N = 58)	%	n (N = 54)	%	n (N = 58)	%	n (N = 63)	%	n (N = 53)	%
One	4	7.0	2	3.6	2	3.6	0	0.0	11	20.4	2	3.4	2	3.2	2	3.8
Two	10	17.5	3	5.5	11	19.6	9	15.5	17	31.5	11	19.0	9	14.3	7	13.2
Three	9	15.8	11	20.0	14	25.0	16	27.6	11	20.4	14	24.1	14	22.2	8	15.1
Four	16	28.1	11	20.0	11	19.6	15	25.9	9	16.7	20	34.5	12	19.0	16	30.2
Five	15	26.3	14	25.5	11	19.6	10	17.2	4	7.4	7	12.1	12	19.0	8	15.1
Six	3	5.3	9	16.4	7	12.5	5	8.6	1	1.9	2	3.4	7	11.1	6	11.3
Seven	0	0.0	2	3.6	0	0.0	1	1.7	1	1.9	1	1.7	3	4.8	4	7.5
Eight	0	0.0	2	3.6	0	0.0	2	3.4	0	0.0	1	1.7	3	4.8	2	3.8
Nine	0	0.0	1	1.8	0	0.0	0	0.0	0	0.0	0	0.0	1	1.6	0	0.0
Total	57	100.0	55	100.0	56	100.0	58	100.0	54	100.0	58	100.0	63	100.0	53	100.0

contrast, only 3.4% of females reported only one activity, also that of urination. The remaining responses were similar to those of the previous two sites. A majority of both males (68.6%) and females (77.6%) reported only two to four activities. Seven activities were the maximum reported by males, while eight was the maximum for females.

The majority of both male (87.7%) and female (81.9%) respondents at the conference center restrooms reported performing two to five activities. Very few males (3.2%) or females (3.8%) performed only one activity. Males reported a maximum of nine activities, while females reported a maximum of eight activities.

At both the rest area and conference center restrooms, males and females were very similar to each other in the mean number of activities performed (see Table 9). At the two remaining sites, the airport and the sports arena, on an average, females performed almost one additional activity than males.

Types of Activities Performed

Four activities listed on the questionnaire were considered not applicable to males. These four activities were: (1) adjust jewelry/scarf, (2) apply make-up, (3) feminine hygiene, and (4) nurse baby. Only one activity

Table 9

Mean Number of Activities Performed in the Restroom by Male and Female Respondents at the Four Restroom Sites

	Number of Activities			
	Males		Females	
Site	N	$\bar{X}$	N	$\bar{X}$
Airport	57	3.65	55	4.51
Rest Area	56	3.70	58	3.95
Sports Arena	54	2.72	58	3.59
Conference Center	63	4.22	53	4.23

was considered not applicable to females, that of straightening a tie. This predominantly male activity did actually have a female counterpart, that of adjusting jewelry or scarf. As previously mentioned, both male and female respondents had opportunities to write in any activities they had performed and which were not listed on the questionnaire (see Appendix A).

The most frequently performed activities, by males at the airport, were urination (89.5%), washing hands (87.7%), checking appearance (73.7%), and straightening clothes (36.8%) (see Table 10). Activities reported by less than 30 percent of the respondents were: combing or brushing hair and straightening a tie. Only a few males washed their face, deficated, talked, or cleaned their glasses. No males reported brushing or flossing their teeth, putting in or taking out their contacts, taking medicine, smoking, waiting on another person, changing a diaper, or assisting a child or children.

The results for women at the airport restroom were similar to those for men with the most performed activities being urination (92.7%), washing hands (92.7%), checking appearance (90.9%), straightening clothes (61.8%), and combing or brushing hair (40.0%) (see Table 10). Fewer than 20% of females waited on another person, applied make-up, adjusted their jewelry or scarf, or talked. Few

Table 10

Activities Performed at the Airport Restrooms by Male and Female Respondents

Activities	Males n (N = 57)	Males %	Females n (N = 55)	Females %
Urinate	51	89.5	51	92.7
Wash hands	50	87.7	51	92.7
Check appearance	42	73.7	50	90.9
Straighten clothes	21	36.8	34	61.8
Comb/brush hair	17	29.8	22	40.0
Straighten tie	15	26.3	NA	NA
Wash face	4	7.0	1	1.8
Deficate	4	7.0	0	0.0
Talk	2	3.5	7	12.7
Change clothes	1	1.8	1	1.8
Clean glasses	1	1.8	1	1.8
Wait on other person	0	0.0	10	18.2
Apply make-up	NA	NA	9	16.4
Adjust jewelry/scarf	NA	NA	8	14.5
Brush/floss teeth	0	0.0	1	1.8
Feminine hygiene	NA	NA	1	1.8
Assist child/children	0	0.0	1	1.8

Note: Multiple responses do not total 100.0%.

females changed their clothes, washed their face, brushed or flossed their teeth, performed feminine hygiene, cleaned their glasses, or assisted a child or children. No females deficated, took medicine, smoked, put in or took out contacts, changed a diaper, or nursed a baby. No males or females indicated that they had performed any activities not listed on the questionnaire, thus indicating that the list of activities was fairly exhaustive.

Grooming activities appeared to be very important to those people using the airport restrooms. Perhaps many of the travelers were businessmen or women, or others traveling in connection with their occupations, as opposed to traveling for pleasure. This could also account for the few or no activities being performed in conjunction with child care, since children are not usually taken on business trips. Females may have been traveling with other people of the same sex more so than males, as almost one-fifth reported that they had waited on another person. Two other activities, smoking and taking medicine, were not listed by either males or females at the airport. Perhaps the waiting area provided a better place in which to smoke. With regard to taking medicine, perhaps the need to take many medicines with water or a beverage made the restroom an inappropriate place to perform this activity. One important characteristic of the airport to keep in mind

when examining the activities performed is, that for many passengers, it is the origin of their flight. There are also relatively few layovers in this airport. Therefore, many of the listed activities may have been performed at their home or a hotel prior to leaving for the airport.

The top five reported activities by males at the rest area were identical to those of the airport and include urination (96.4%), washing hands (96.4%), checking appearance (62.5%), straightening clothes (42.9%), and combing or brushing hair (19.6%) (see Table 11). One additional activity, not often performed by males at the airport restroom, was talking (14.3%). This could be the result of people traveling together in a car or tour bus, since 8.9% of the male and 17.2% of the female respondents reported having to wait on another person.

The top activities reported by females at the rest area were the same as those listed by males at the rest area, though in a slightly different order--washing hands (100.0%), urination (91.4%), checking appearance (75.9%), straightening clothes (50.0%), combing or brushing hair (20.7%), waiting on another person (17.2%), and talking (15.5%) (see Table 11).

Grooming activities were important activities, even at the rest area, for both males and females, just as they were at the airport. Many of the people stopping at the

Table 11

Activities Performed in the Rest Area Restrooms by Male and Female Respondents

Activities	Males n (N = 56)	Males %	Females n (N = 58)	Females %
Wash hands	54	96.4	58	100.0
Urinate	54	96.4	53	91.4
Check appearance	35	62.5	44	75.9
Straighten clothes	24	42.9	29	50.0
Comb/brush hair	11	19.6	12	20.7
Talk	8	14.3	9	15.5
Wait on other person	5	8.9	10	17.2
Wash face	4	7.1	3	5.2
Deficate	4	7.1	3	5.2
Smoke	4	7.1	2	3.4
Clean glasses	2	3.6	0	0.0
Change clothes	1	1.8	0	0.0
Brush/floss teeth	1	1.8	0	0.0
Feminine hygiene	NA	NA	2	3.4
Adjust jewelry/scarf	NA	NA	1	1.7
Apply make-up	NA	NA	1	1.7
Put in/take out contacts	0	0.0	1	1.7
Assist child/children	0	0.0	1	1.7

Note: Multiple responses do not total 100.0%.

rest area were casually dressed which could explain why no males reported straightening their tie and only a few females reported adjusting their jewelry or scarf or applying make-up. In addition, child care activities were not often reported by either males or females, which is somewhat surprising. Several women declined to fill out the questionnaire because they had chilren with them. Therefore, the people who actually performed child care activities could have been under-represented in the study by their refusal to participate.

The predominant activities of males at the sports arena restroom were similar to those of males at the airport and the rest area, and included urination (98.1%), washing hands (74.1%), checking appearance (38.9%), waiting on another person (14.8%), combing or brushing hair (9.3%), and talking (9.3%) (see Table 12). A lower percentage of males reported washing their hands at this site than at the other three sites. Grooming activities were performed at a much lower percentage level than at the other three sites. This could be a reflection of the casual nature of attending a basketball game.

Females, on the other hand, reported a high percentage of hand washing activity (89.7%), equal to that of urination (89.7%) (see Table 12). A higher percentage of females reported grooming activities than did males,

Table 12

Activities Performed in the Sports Arena Restrooms by Male and Female Respondents

Activities	Males n (N = 54)	Males %	Females n (N = 58)	Females %
Urinate	53	98.1	52	89.7
Wash hands	40	74.1	52	89.7
Check appearance	21	38.9	41	70.7
Wait on other person	8	14.8	5	8.6
Comb/brush hair	5	9.3	13	22.4
Talk	5	9.3	4	6.9
Straighten clothes	4	7.4	26	44.8
Assist child/children	3	5.6	4	6.9
Clean glasses	3	5.6	0	0.0
Straighten tie	2	3.7	NA	NA
Deficate	1	1.9	2	3.4
Smoke	1	1.9	2	3.4
Wash face	1	1.9	0	0.0
Adjust jewelry/scarf	NA	NA	2	3.4
Apply make-up	NA	NA	2	3.4
Change diaper	0	0.0	1	1.7
Other	0	0.0	2	3.4

Note: Multiple responses do not total 100.0%.

including checking appearance (70.7%), straightening clothing (48.8%), and combing or brushing their hair (22.4%). In fact, slightly over 10% of females went into the restroom for reasons other than elimination. Additional activities listed by a small percentage of females were "blow nose" and "check appearance of the bathroom."

The responses from male restroom users at the conference center were similar to those at the airport and rest area, with the exception of talking, in which over one-third of the males engaged (see Table 13). One possible explanation for the high incidence of talking was that these men were professional collegues who knew each other and who did not see each other very often. Additional activities listed by a small percentage of the males were "read paper" and "blow nose."

The results from the female respondents are very different from the females at the other three sites in that urination was ranked as the third most performed activity (79.2%), with checking appearance the most performed (88.7%) (see Table 13). Slightly over one-fifth of the females went to the restroom for reasons other than elimination. Another finding is that this site had the lowest incidence of hand washing by females (83.0%). This appears to be related to the low incidence of elimination

Table 13

Activities Performed at the Conference Center Restrooms by Male and Female Respondents

Activities	Males n (N = 63)	Males %	Females n (N = 53)	Females %
Urinate	60	95.2	42	79.2
Wash hands	58	92.1	44	83.0
Check appearance	48	76.2	47	88.7
Talk	22	34.9	13	24.5
Straighten clothes	21	33.3	31	58.5
Straighten tie	19	30.2	NA	NA
Comb/brush hair	12	19.0	15	28.3
Deficate	12	19.0	4	7.5
Smoke	3	4.8	2	3.8
Wash face	3	4.8	1	1.9
Wait on other person	2	3.2	3	5.7
Clean glasses	2	3.2	2	3.8
Assist child/children	2	3.2	0	0.0
Adjust jewelry/scarf	NA	NA	8	15.1
Apply make-up	NA	NA	6	11.3
Feminine hygiene	NA	NA	2	3.8
Take medicine	0	0.0	2	3.8
Put in/take out contacts	0	0.0	1	1.9
Other	2	3.2	0	0.0

Note: Multiple responses do not total 100.0%.

activities and the higher incidence of checking appearance at this site.

Aggregates of Activities

With a large number of possible restroom activities, there was a myriad of possible aggregates of activities. Surprisingly, the fewest aggregates of activities exibited at any site was 25 (sports arena, females), while the maximum was 37 (conference center, males) (see Table 14). It should be noted that the sequencing of the activities is unknown. But, the sum of the types of activities performed by a person in a single restroom visit, in this instance, constitutes a "aggregate."

Males at the airport restroom exhibited six aggregates of activities, each having only a few respondents (see Table 15). Almost 20% of the females performed the following aggregate of activity, urinate--wash hands--check appearance.

Identical aggregtes of activities emerged for both male and female users of the restrooms at the rest area, though in a slightly different ordering (see Table 16). The three aggregates were: (1) urinate--wash hands (males, 17.9%; females, 10.4%); (2) urinate--wash hands--check appearance--straighten clothes (males, 16.1%; females,

Table 14

Number of Different Aggregates of Activities Performed by Male and Female Respondents at the Four Restroom Sites

Site	Males	Females
Airport	26	30
Rest Area	27	29
Sports Arena	21	25
Conference Center	37	36

Table 15

Most Frequent Aggregates of Activities by Males and Females at the Airport Restrooms

Pattern	Males n (N = 57)	%
Urinate--wash hands	6	10.5
Urinate--wash hands--check appearance--check tie	5	8.8
Urinate--wash hands--check appearance--check tie--straighten clothes	5	8.8
Urinate--wash hands--check appearance--comb/brush hair	5	8.8
Urinate--wash hands--check appearance	4	7.0
Urinate--wash hands--check apperance--straighten clothes--comb/brush hair	4	7.0
Additional patterns	28	49.1
Total	57	100.0
	Females n (N = 55)	**%**
Urinate--wash hands--check appearance	10	18.2
Urinate--wash hands--check apparance--comb/brush hair--straighten clothes	7	12.7
Urinate--wash hands--check appearance--straighten clothes	6	10.9
Additional patterns	32	58.2
Total	55	100.0

Table 16

Most Frequent Aggregates of Activities by Males and Females at the Rest Area Restrooms

Pattern	Males n (N = 56)	%
Urinate--wash hands	10	17.9
Urinate--wash hands--check appearance--straighten clothes	9	16.1
Urinate--wash hands--check appearance	6	10.7
Additional patterns	31	55.3
Total	56	100.0
	Females	
	n (N = 58)	%
Urinate--wash hands--check appearance--straighten clothes	10	17.2
Urinate--wash hands--check apparance	7	12.1
Urinate--wash hands	6	10.4
Additional patterns	35	60.3
Total	58	100.0

12.1%); and (3) urinate--wash hands--check appearance (males, 10.7%; females, 10.4%).

Almost 28% of male users of the sports arena restroom reported only urinating and washing their hands (see Table 17) . One-fifth reported urinating only, while almost 10% urinated, washed their hands, and checked their appearance. Slightly over one-fourth of the females at the sports arena restroom performed the following aggregate of activities, urinate--wash hands--check appearance--straighten clothes. The other two predominant aggregates of activities were: (1) urinate--wash hands (15.5%) and (2) urinate--wash hands--check appearance (13.8%).

At the conference center restrooms, males had twice as many predominant aggregates of activities as females (see Table 18). Of the four sites, the airport appears to be the most different from the other three, especially for males.

Most Time-Consuming Activities

The most time-consuming activity, for both males and females, at all four sites, was reported to be that of urination. The second most often reported time-consuming

Table 17

Most Frequent Aggregates of Activities by Males and Females at the Sports Arena Restrooms

Pattern	Males n (N = 54)	%
Urinate--wash hands	15	27.8
Urinate	11	20.4
Urinate--wash hands--check appearance	5	9.2
Additional patterns	23	42.6
Total	54	100.0
	Females n (N = 58)	%
Urinate--wash hands--check appearance--straighten clothes	15	25.9
Urinate--wash hands	9	15.5
Urinate--wash hands--check appearance	8	13.8
Additional patterns	26	44.8
Total	58	100.0

Table 18

Most Frequent Aggregates of Activities by Males and Females at the Conference Center Restrooms

Pattern	Males n (N = 63)	%
Urinate--wash hands--check appearance	10	15.9
Urinate--wash hands	7	11.1
Urinate--wash hands--check appearance--talk	5	7.9
Urinate--wash hands--check appearance--straighten clothes	4	6.4
Additional patterns	37	58.7
Total	63	100.0
	Females n (N = 53)	%
Urinate--wash hands--check appearance--straighten clothes	11	20.8
Urinate--wash hands--check appearance	5	9.4
Additional patterns	37	69.8
Total	53	100.0

activity for both males and females at three of the four sites was washing hands (see Tables 19, 20, and 21). The exception to this finding was at the conference center, where the second most reported time-consuming activity for males was defication (19.0%), and for females it was straightening clothes (13.9%) (see Table 22).

Time Spent in the Restroom

Female respondents and nonrespondents spent more time in the restroom than males, at all four sites (see Table 23). For respondents, time ranged from almost 55% longer for females than for males at the sports arena (males, 83.6 seconds; females, 152.5 seconds) to almost 65% longer at the airport (males, 112.5 seconds; females, 175.3 seconds). For nonrespondents, time ranged from almost 45% longer for females than for males at the sports arena (males, 70.5 seconds; females, 157.0 seconds) to approximately 75% longer at the airport (males, 120.9 seconds; females, 167.8 seconds).

Waiting Lines

Waiting lines were apparently not a problem for either males or females at the airport, as only one female reported having to stand in line. Lines were reported at

Table 19

Activities Which Took the Most Time for Male and Female Respondents at the Airport Restrooms

Activities	Males n (N = 34)	Males %	Females n (N = 40)	Females %
Urinate	19	55.9	16	40.0
Wash hands	4	11.8	6	15.0
Check appearance	3	8.8	2	5.0
Straighten tie	2	5.9	NA	NA
Comb/brush hair	1	2.9	2	5.0
Change clothes	1	2.9	1	2.5
Deficate	1	2.9	0	0.0
Straighten clothes	0	0.0	3	7.5
Wash face	0	0.0	1	2.5
Wait on other person	0	0.0	1	2.5
Assist child/children	0	0.0	1	2.5
Apply make-up	NA	NA	1	2.5
Other	3	8.8	6	15.0
Total	34	100.0	40	100.0

Table 20

Activities Which Took the Most Time for Male and Female Respondents at the Rest Area Restrooms

Activities	Males n (N = 14)	Males %	Females n (N = 30)	Females %
Urinate	7	50.0	12	40.0
Wash hands	3	21.4	5	16.7
Deficate	1	7.1	3	10.0
Wait on other person	1	7.1	0	0.0
Comb/brush hair	0	0.0	3	10.0
Assist child/children	0	0.0	1	3.3
Check appearance	0	0.0	1	3.3
Other	2	14.3	5	16.7
Total	14	100.0	30	100.0

Table 21

Activities Which Took the Most Time for Male and Female Respondents at the Sports Arena Restrooms

Activities	Males n (N = 26)	Males %	Females n (N = 40)	Females %
Urinate	20	76.9	16	40.0
Wash hands	2	7.7	6	15.0
Wait on other person	1	3.8	0	0.0
Straighten clothes	0	0.0	5	12.5
Assist child/children	0	0.0	3	7.5
Talk	0	0.0	2	5.0
Check appearance	0	0.0	1	2.5
Deficate	0	0.0	1	2.5
Change diaper	0	0.0	1	2.5
Other	3	11.5	5	12.5
Total	26	100.0	40	100.0

Table 22

Activities Which Took the Most Time for Male and Female Respondents at the Conference Center Restrooms

Activities	Males n (N = 42)	Males %	Females n (N = 36)	Females %
Urinate	24	57.1	19	52.8
Deficate	8	19.0	2	5.6
Wash hands	4	9.5	2	5.6
Talk	4	9.5	2	5.6
Comb/brush hair	1	2.4	2	5.6
Straighten clothes	0	0.0	5	13.9
Check appearance	0	0.0	3	8.3
Other	1	2.4	1	2.8
Total	42	100.0	36	100.0

Table 23

Mean Time Spent in the Restroom by Male and Female Respondents and Nonrespondents at the Four Restroom Sites

	Time (seconds)			
	Males		Females	
Site	N	$\bar{X}$	N	$\bar{X}$
Respondents				
Airport	57	112.5	55	175.3
Rest Area	56	108.6	58	180.6
Sports Arena	54	83.6	58	152.5
Conference Center	63	93.3	53	163.5
Nonrespondents				
Airport	56	120.9	44	167.8
Rest Area	19	116.7	34	212.5
Sports Arena	34	70.5	32	157.0
Conference Center	13	83.2	6	145.1

the other three sites for both males and females, however. A slightly larger percentage of males (15.4%) than females (13.8%) reported having to stand in line at the sports arena (see Table 24). At the rest area, twice as many females stood in line (29.3%) as did males (14.5%), while at the conference center, almost three times as many females (9.4%) as males (3.2%) stood in line. Waiting at all sites was usually for no more than five minutes.

Fixtures Used

Consistently, across all four sites, males used the elimination fixtures in the following ratio, two-thirds used the urinal, while one-third used the regular stall (see Table 25). Males rarely used the handicapped stall. The majority of females at all four sites reported using the regular stall. The handicapped stall was used most often by females at the conference center restroom. It should be noted here that there were no handicapped stalls in the sports arena restrooms under study, for either males or females. In the women's restroom, however, there were eight female urinals. Since their presence in a women's restroom was an unexpected and rare occurrence, the female questionnaire did not list urinal as a fixture choice. They were counted as regular stalls, since they appeared to

Table 24

Presence of Lines at Male and Female Restrooms as Reported by Respondents at the Four Restroom Sites

Presence of Lines	Airport				Rest Area				Sports Arena				Conference Center			
	Males		Females		Males		Females		Males		Females		Males		Females	
	n (N = 57)	%	n (N = 55)	%	n (N = 56)	%	n (N = 58)	%	n (N = 52)	%	n (N = 58)	%	n (N = 63)	%	n (N = 53)	%
Stood in Line																
Yes	0	0.0	1	1.8	8	14.5	17	29.3	8	15.4	8	13.8	2	3.2	5	9.4
No	57	100.0	54	98.2	47	85.5	41	70.7	44	84.6	50	86.2	61	96.8	48	90.6
Total	57	100.0	55	100.0	56	100.0	58	100.0	52	100.0	58	100.0	63	100.0	53	100.0
Amount of Time Spent in Line																
more than 5 minutes	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	1.7	0	0.0	1	1.9
1 to 5 minutes	0	0.0	0	0.0	3	5.6	11	19.0	1	1.9	3	5.2	1	1.6	2	3.8
less than 1 minute	0	0.0	1	1.8	4	7.4	6	10.3	7	13.5	4	6.9	1	1.6	2	3.8
not applicable	57	100.0	54	98.2	47	87.0	41	70.7	44	84.6	50	86.2	61	96.8	48	90.6
Total	57	100.0	55	100.0	54	100.0	58	100.0	52	100.0	58	100.0	63	100.0	53	100.0

Table 25

Fixtures Used by Male and Female Restroom Users at the Four Sites

Fixture Used/Site	Males N	Males n	Males %	Females N	Females n	Females %
Airport						
Regular Stall	57	17	29.8	55	51	92.7
Handicapped Stall	57	0	0.0	55	1	1.8
Urinal	57	39	68.4	55	NA	NA
Rest Area						
Regular Stall	51	16	31.4	57	54	94.7
Handicapped Stall	50	0	0.0	57	2	3.5
Urinal	50	35	70.0	58	NA	NA
Sports Arena						
Regular Stall	50	15	30.0	58	58	100.0
Handicapped Stall	50	NA	NA	58	NA	NA
Urinal	50	35	70.0	58	NA	NA
Conference Center						
Regular Stall	62	20	32.3	53	41	77.4
Handicapped Stall	62	5	8.1	53	7	13.2
Urinal	62	41	66.1	53	NA	NA

be used by females in the same way they would a regular stall for whatever activities they were performing, as opposed to male urinals which are used only for a single, specific purpose. At several of the sites, there were instances of both males and females using the regular stall for purposes other than elimination, possibly for the purpose of checking appearance or straightening clothes.

Fixtures/Features Liked Most

About one-third of the male respondents at the airport reported that there was "nothing in particular" that they liked about the restroom (see Table 26). One-fifth of each reported "availability" and "paper towels" as the features they liked most. "No waiting" was most-liked by 12%, while almost one-third reported "other" features. On the other hand, almost two-thirds of the females reported that the "cleanliness" of the restroom was what they liked most. Additional features reported by females as being most-liked included: "no waiting" (10.9%), "availability/relief" (8.7%), "paper seat covers" (6.5%), and "spaciousness" (6.5%). Almost one-fifth listed "other" features.

About 80% of both male and female respondents at the rest area restroom reported cleanliness as the most-liked feature (see Table 27). Males then reported

Table 26

Most Liked Features of the Airport Restrooms

Feature	Males n (N = 25)	%
Nothing in particular	8	32.0
Availability	5	20.0
Paper towels	5	20.0
No waiting	3	12.0
Other features	8	32.0
	Females	
	n (N = 46)	%
Cleanliness	29	63.0
No waiting	5	10.9
Availability/relief	4	8.7
Paper seat covers	3	6.5
Spacious	3	6.5
Other features	10	21.7

Note: Multiple responses do not total 100.0%.

Table 27

Most Liked Features of the Rest Area Restrooms

Feature	Males n (N = 39)	Males %
Cleanliness	31	79.5
Availability/relief	3	7.7
Paper towels	3	7.7
Privacy	3	7.7
Other features	6	15.4
	Females	
	n (N = 47)	**%**
Cleanliness	38	80.9
Faucets	4	8.5
Hot water	2	4.3
Other features	8	17.0

Note: Multiple responses do not total 100.0%.

availability/relief (7.7%), paper towels (7.7%), and privacy (7.7%). Females reported different features as being most-liked, including the faucets (8.5%) and hot water (4.3%). It should be noted that this was a very clean restroom, as custodial workers cleaned it on a regular basis at least every hour.

The most-liked feature by male respondents at the sports arena was restroom availability (27.8%), otherwise they found nothing in particular to like about the restroom (27.8%) (see Table 28). Females appreciated the cleanliness (39.1%) and not having to wait in line (13.0%). Another favorite feature was the large roll of toilet tissue and its accompanying dispenser in each stall (13.0%).

Cleanliness was listed by almost 50% of the male respondents at the conference center (see Table 29). The availability of the restroom was listed by over one-quarter of the males. Paper towels (7.5%) and soap (7.5%) were the third most-liked features. The top two most-liked features listed by females are the same as those listed by males at the facility--cleanliness (58.5%) and availability/relief (12.2%).

Cleanliness of the restroom was the most often mentioned favorite feature by both males and females at the various sites. Males, at three of the four sites, listed

Table 28

Most Liked Features of the Sports Arena Restrooms

Feature	Males n (N = 36)	Males %
Availability/relief	10	27.8
Nothing in particular/It was O.K.	10	27.8
Cleanliness	6	16.7
No waiting	3	8.3
Other features	9	25.0

	Females n (N = 46)	Females %
Cleanliness	18	39.1
No waiting	6	13.0
Toilet paper and dispenser	6	13.0
Large number of stalls	4	8.7
Lighting	4	8.7
Nothing in particular	4	8.7
Spacious	3	6.5
Mirrors	3	6.5
Other features	3	6.5

Note: Multiple responses do not total 100.0%.

Table 29

Most Liked Features of the Conference Center Restrooms

Feature	Males n (N = 40)	Males %
Cleanliness	19	47.5
Availability/relief	11	27.5
Paper towels	3	7.5
Soap	3	7.5
No waiting	2	5.0
Lighting	2	5.0
Other features	4	10.0
	Females	
	n (N = 41)	**%**
Cleanliness	24	58.5
Availability/relief	5	12.2
Decor/color	4	9.8
Lighting	3	7.3
Paper towels	2	4.9
Soap	2	4.9
Other features	3	7.3

Note: Multiple responses do not total 100.0%.

paper towels among their top choices for the most-liked feature.

Suggestions for Improvement

Over one-third of the male respondents at the airport reported that cleaning the restroom would have improved it (see Table 30), followed by layout and space changes (10.5%). Additional improvements concerned better ventilation/smell (7.0%), remodel/update (7.0%), and better maintenance (3.5%). Almost 60% had no suggestions for improvement. "No suggestions" includes both those who reported they had no suggestions, plus those leaving the question blank, implying that they had no suggestions. Almost 75% of the females had no suggestions for improvement of the airport restroom indicating a high degree of satisfaction. Almost 10% suggested that the restroom could use some remodeling or updating. It is interesting to note that both males and females mentioned the need for remodeling or updating the airport restrooms.

The restroom at the rest area appeared to be liked as is, with slightly over 75% of each sex indicating they had no suggestions for improvement (see Table 31). Males thought the restroom should be larger (3.6%), while females thought it could have more stalls (5.2%), be cleaned

Table 30

Features Suggested to Improve the Airport Restrooms

Feature	Males n (N = 57)	Males %
Cleaning	11	19.3
Layout/space changes	6	10.5
Better ventilation/smell	4	7.0
Remodel/update	4	7.0
Better maintenance	2	3.5
Other suggestions	4	7.0
No suggestions*	33	57.9
	Females	
	n (N = 55)	%
Remodel/update	5	9.1
Cleaning	2	3.6
Additional lighting	2	3.6
Other suggestions	6	10.9
No suggestions*	41	74.5

*"No suggestions" includes both those who reported they had no suggestions, plus those leaving the question blank, implying that they had no suggestions.

Note: Multiple responses do not total 100.0%.

Table 31

Features Suggested to Improve the Rest Area Restrooms

Feature	Males n (N = 56)	Males %
Larger space	2	3.6
Other suggestions	6	10.7
No suggestions*	48	85.7
	Females	
	n (N = 58)	%
More stalls	3	5.2
Cleaning	3	5.2
Different faucet/better use instructions	2	3.4
Less disinfectant smell	2	3.4
More ventilation	2	3.4
Other suggestions	5	8.6
No suggestions*	45	77.6

*"No suggestions" includes both those who reported that they had no suggestions, plus those leaving the question blank, implying that they had no suggestions.

Note: Multiple responses do not total 100.0%.

(5.2%), have a different type of faucet or at least better instructions on how to use the faucet (3.4%), less odor of a disinfectant (3.4%), and more ventillation (3.4%).

Approximately two-thirds of the male respondents at the sports arena had no suggestions for improvement (see Table 32). Some of the male respondents, however, thought that more paper towels (9.3%) and a cleaning (7.4%) would be improvements. One-fifth of the females reported that the restroom needed more paper towels, (the paper towel supply was depleted sometime during the game). Almost 14% reported that the restroom could use some cleaning, while slightly over 50% had no suggestions.

Almost two-thirds of the male respondents and over one-half of the female respondents using the conference center restrooms had no suggestions for improvement (see Table 33). Males reported wanting more urinals (6.3%), partitions between the urinals (4.8%), and to have the restroom a little cleaner (4.8%). Males at this site reported wanting air dryers for their hands (4.8%). Females suggested that more space was needed in the restroom (15.1%). Additional suggestions made by females for improvement included: counter space/dressing table (5.7%), more toilet tissue (it ran out) (5.7%), change in decor (3.8%), better ventilation (3.8%), warmer (3.8%), and music (3.8%).

Table 32

Features Suggested to Improve the Sports Arena Restrooms

Feature	Males n (N = 54)	Males %
More paper towels	5	9.3
Cleaning	4	7.4
More trash receptacles	2	3.7
Mirrors	2	3.7
More stalls	2	3.7
Better smell	2	3.7
Other suggestions	4	7.4
No suggestions*	33	61.1
	Females	
	n (N = 58)	%
More paper towels	12	20.7
Cleaning	8	13.8
Remove urinals	4	6.9
Different/better flushing mechanism	2	3.4
Other suggestions	6	10.3
No suggestions*	32	55.2

*"No suggestions" includes both those who reported that they had no suggestions, plus those leaving the question blank, implying that they had no suggestions.

Note: Multiple responses do not total 100.0%.

Table 33

Features Suggested to Improve the Conference Center Restrooms

Feature	Males n (N = 63)	Males %
More urinals	4	6.3
Partitions between urinals	3	4.8
Air dryers for hands	3	4.8
Cleaning	3	4.8
Better smell	2	3.2
Move towel dispensers	2	3.2
Other suggestions	9	14.3
No suggestions*	40	63.5
	Females	
	n (N = 53)	**%**
More space	8	15.1
Counter space/dressing table	3	5.7
More toilet tissue	3	5.7
Decor	2	3.8
Ventilation	2	3.8
Warmer	2	3.8
Music	2	3.8
Other suggestions	7	13.2
No suggestions*	27	50.9

*"No suggestions" includes both those who reported that they had no suggestions, plus those leaving the question blank, implying that they had no suggestions.

Note: Multiple responses do not total 100.0%.

Age

Most of the respondents, both male and female, at all four sites, were under 65 years of age (see Table 34). This is consistent with the use of both the airport and conference center, since a majority of the users were still employed and were at these sites in conjuction with their jobs, whereas many people age 65 and over are more likely to be retired. Among the four sites, the rest area had the highest percentage of both male and female users over age 65, with about 20% each. More people of this age would be free to travel on a weekday, when about one-half of the data were collected. At the sports arena, almost 14% of the male respondents were over age 65, while only about 4% of the females were in this age category. If many of those attending the games were married couples, perhaps the husbands were somewhat older than the wives, in keeping with a societal norm.

Summary and Discussion

At all four sites, the majority of males and females performed from two to five activities. The top three most often performed activities, by both sexes, at all four sites, were urination, washing hands, and checking appearance. At three of the four sites (rest area, sports

Table 34

Ages of Male and Female Respondents at the Four Restroom Sites

Age Category/Site	Males n	Males %	Females n	Females %
Airport	(N = 53)		(N = 54)	
35 years or less	16	30.2	18	33.3
36 - 64 years	34	64.1	34	63.0
more than 64 years	3	5.7	2	3.7
Total	53	100.0	54	100.0
Rest Area	(N = 56)		(N = 54)	
35 years or less	9	16.1	8	14.8
36 - 64 years	35	62.5	34	63.0
more than 64 years	12	21.4	12	22.2
Total	56	100.0	54	100.0
Sports Arena	(N = 51)		(N = 56)	
35 years or less	24	47.1	30	53.6
36 - 64 years	20	39.2	24	42.8
more than 64 years	7	13.7	2	3.6
Total	51	100.0	56	100.0
Conference Center	(N = 58)		(N = 52)	
35 years or less	23	39.7	30	57.7
36 - 64 years	35	60.3	22	42.3
Total	58	100.0	52	100.0

arena, and conference center), a greater percentage of males performed the activity of urination than did females. This agrees with the findings of Henning (1977), that 91% of males used either the water closet or urinal, while only 79% of females used the water closet. From the current study, the two major aggregates of activities were (1) urinate--wash hands--check appearance and (2) urinate--wash hands. This is in partial agreement with Henning (1977), who found the predominant pattern for males to be enter--urinal--exit, while for females the major pattern was enter--water closet--wash basin--dry--exit. The findings also correspond, in part, with those of McCall, Gleye, and Singer (1971), who reported the two major patterns of use, for males, to be (1) enter--urinate--wash--dry--exit and (2) enter--urinate--exit. The current study found a greater incidence of hand washing by both males and females than did the other studies (Henning, 1977; McCall, Gleye, & Singer, 1971; Pederson, Keithly, & Brady, 1986). Possible reasons for this include: location of sinks, self-reporting of the activities, other people were present in the restroom, and adequate supplies, such as warm water, soap, and paper towels. Urination and washing hands were the two most often reported time-consuming activities. At all four sites, females spent more time in the restroom than males which substantiates a

finding by Henning (1977) in which males spent an average of 117 seconds in the restroom, while females spent an average of 185 seconds. In the current study, the mean time spent in the restroom by female respondents ranged from 152.5 seconds (sports arena) to 180.6 seconds (rest area). The mean time spent in the restroom by female nonrespondents ranged from 145.1 seconds (conference center) to 212.5 seconds (rest area). The mean time spent in the restroom by male respondents ranged from 83.6 seconds (sports arena) to 112.5 sconds (airport). The mean time spent in the restroom by male nonrespondents ranged from 70.5 seconds (sports arena) to 120.9 seconds (airport). Both males and females reported having to stand in line at three of the sites, rest area, sports arena, and conference center. But, at the sports arena and conference center, a greater percentage of females had to stand in line. For both males and females, waits were usually less than five minutes. Consistantly, across all four sites, males used the elimination fixtures in the following ratio, two-thirds used the urinal, while one-third used the regular stall. The majority of females at all four sites reported using the regular stall. At all four sites, for both males and females, the most liked features included availability/relief, cleanliness, and paper towels. McCall, Gleye, and Singer (1971) reported males preferred

paper towels to air dryers for hands. Suggestions for restroom improvement were more site specific than the "most liked features" of the restrooms, but included cleaning and more paper towels

Statistical Analyses

Examination of the Hypotheses

Hol and Hal. Four independent sample t-tests were used to determine the differences in the amount of time spent in the restroom by male and female respondents at the four sites. There were significant differences ($p < .001$) between males and females at all four sites (see Table 35). Females spent a significantly greater amount of time in the restroom than did males. Females at both the airport and rest area spent approximately 60% longer in the restroom than males, while at the sports arena and conference center, they spent 55% longer (see Table 23). The null hypothesis was rejected in all cases, resulting in the alternate hypothesis being retained. Since there were uneven numbers of subjects in the groups, the assumption of equal variances was tested.

Table 35

Differences in Mean Time Spent in the Restroom by Males and Females at the Four Restroom Sites

Sex	N	M	SD	t	p
Airport					
Males	57	112.5	77.2	4.07	<.001
Females	55	175.3	86.0		
Rest Area					
Males	56	108.6	44.6	7.71	<.001
Females	58	180.6	54.5		
Sports Arena					
Males	54	83.6	69.7	4.51	<.001
Females	58	152.5	89.9		
Conference Center					
Males	63	93.3	29.5	4.89	<.001
Females	53	163.5	100.9		

Ho2 and Ha2. Four independent sample t-tests were used to determine the differences in the number of activities performed in the restroom by males and females at the four sites. There were significant differences between males and females in the number of activities they performed in the restroom at two of the sites--airport ($p < .005$) and sports arena ($p < .001$), with females performing significantly more activities than males (see Table 36). At the remaining two sites, both males and females performed approximately an equal number of activities. For the airport and sports arena the null hypothesis was rejected and the alternate hypothesis retained, while for the rest area and conference center, the null hypothesis was retained. Since there were uneven numbers of subjects in the groups, the assumption of equal variances was tested.

Ho3 and Ha3. Eight Pearson product-moment correlations were used to test whether there was a significant relationship between age and the amount of time spent in the restroom. For both males and females at all four sites, there were no significant relationships between age and the amount of time spent in the restroom (see Table 37). Two of the strongest correlations, females at the

Table 36

Differences in Mean Number of Activities Performed in the Restroom by Males and Females at the Four Restroom Sites

Sex	N	M	SD	t	p
Airport					
Males	57	3.7	1.4	2.98	<.005
Females	55	4.5	1.7		
Rest Area					
Males	56	3.7	1.4	0.93	NS
Females	58	3.9	1.5		
Sports Arena					
Males	54	2.7	1.4	3.28	<.001
Females	58	3.6	1.4		
Conference Center					
Males	63	4.2	1.8	0.01	NS
Females	53	4.2	1.7		

Table 37

Product-Moment Correlations Between Age and Amount of Time Spent in the Restroom by Males and Females at the Four Restroom Sites

Subjects	r	r2	p
Airport			
Males (N = 53)	.0219 (p = .438)	.000	NS
Females (N = 54)	.2207 (p = .054)	.048	NS
Rest Area			
Males (N = 56)	.1646 (p = .113)	.027	NS
Females (N = 54)	.0401 (p = .387)	.001	NS
Sports Arena			
Males (N = 51)	.2129 (p = .067)	.045	NS
Females (N = 56)	.0953 (p = .242)	.009	NS
Conference Center			
Males (N = 58)	-.0031 (p = .491)	.000	NS
Females (N = 52)	.1243 (p = .190)	.015	NS

airport (r = .2207) and males at the sports arena (r = .2129), however, were very close to the .05 level (though exceeded it) and suggest that in certain circumstances, there is a positive relationship between age and time spent in the restroom--as a person gets older, they tend to spend more time in the restroom. The scattergrams also suggest a slight positive relationship (see Appendix B). The low coefficients of determination (r2), however, show that age is not a good predictor of the amount of time spent in the restroom. The null hypothesis was retained in all cases, while the alternate hypothesis was rejected.

Ho4 and Ha4. Two tests of equal proportion, one for each of two sites (rest area and sports arena), were used to test whether there was a significant difference between males and females and how often they have to stand in line to use the restroom. Only peak times were examined, since this is when most waiting lines would form. A test was not performed for the airport, since neither males nor females stood in line. Neither was a test performed for the conference center, due to the small number of subjects who stood in line. Although not statistically determined, the numbers indicate that females may be more apt to have to stand in line than males at the confrence center. Tests were conducted for the rest area and sports arena. A test

statistic of 1.872 ($p < .05$) was calculated for the rest area, and 1.926 ($p < .05$) for the sports arena (see Table 38). Females at these two sites are significantly more likely to have to stand in lines to use the restroom than males.

Ho5 and Ha5. A comparison of ratios was used to examine the difference between men's and women's restrooms and the number of users which can be accommodated. For each site, a ratio of female to male elimination fixtures was calculated. Then using times from nonpeak periods, a mean time spent in the restroom was calculated for both males and females. A ratio of female time to male time was also calculated. In order to process an equal number of people in a given period of time, the ratio of elimination fixtures in the restrooms should be equal to the time ratio. As can be seen, none of the sites have restrooms with elimination fixtures in the indicated proportions (see Table 39). It should be noted here that for females at the sports arena, there were 16 elimination fixtures, eight of which were female urinals. It is not known if the women used the urinals as much as they used the water closets, or if they were more inclined to wait until a water closet

Table 38

Test of Equal Proportions to Determine Whether Females Have to Stand in Line More Often Than Males

Sex	N at Peak	N Stood in Line	Test Statistic	p
Airport				
Males	20	0	could not test	
Females	19	0		
Rest Area				
Males	32	5	1.872	<.05
Females	24	9		
Sports Arena				
Males	21	3	1.926	<.05
Females	14	6		
Conference Center				
Males	7	1	could not test	
Females	3	3		

Table 39

Comparison of Ratios of Male and Female Elimination Fixtures to Ratios of Time Spent in the Restroom by Males and Females

Site	Fixture Ratios	Time Ratios
	$\frac{N \text{ (fixtures/females)}}{N \text{ (fixtures/males)}}$	$\frac{\bar{X} \text{ (time/females)}}{\bar{X} \text{ (time/males)}}$
Airport	8/11 = .73	181.0/118.0 = 1.53
Rest Area	6/6 = 1.00	188.2/110.7 = 1.70
Sports Arena	16/15 = 1.06	147.2/72.2 = 2.02
Conference Center	5/8 = .63	155.1/89.7 = 1.73

became available for use. Waiting to use a water closet could account for the high time ratio. The mean time for females, however, was not much different from the mean times of females at the other three sites.

Ho6. Eight Pearson product-moment correlations were used to test whether there was a significant relationship between the amount of time spent in the restroom and the number of activities performed. For the following groups, there was a significant relationship between the amount of time spent in the restroom and the number of activities performed--females at the airport ($r = .4289$, $p < .005$) and sports arena ($r = .2895$, $p < .001$), and males at the rest area ($r = .2841$, $p < .05$) (see Table 40). The scattergrams confirm this positive relationship (see Appendix B). The low coefficients of determination (r2), however, show that number of activities performed is not a good predictor of the amount of time spent in the restroom. For the aforementioned three groups (females at the airport and sports arena, and males at the rest area), the null hypothesis was rejected, while for the remaining five groups, the null hypothesis was retained.

Table 40

Product-Moment Correlations Between Amount of Time Spent in the Restroom and Number of Activities Performed by Males and Females at the Four Restroom Sites

Subjects	r	r2	p
Airport			
Males (N = 57)	.1222 (p = .365)	.014	NS
Females (N = 55)	.4289 (p = .001)	.183	<.005
Rest Area			
Males (N = 56)	.2841 (p = .034)	.080	<.05
Females (N = 58)	.2088 (p = .116)	.043	NS
Sports Arena			
Males (N = 54)	.1411 (p = .309)	.019	NS
Females (N = 58)	.4895 (p = .000)	.239	<.001
Conference Center			
Males (N = 63)	.0764 (p = .552)	.005	NS
Females (N = 53)	.2410 (p = .082)	.058	NS

Ho7. Eight Pearson product-moment correlations were used to test whether there was a significant relationship between age and number of activities performed. For both males and females at three of the four sites (airport, rest area, and sports arena), plus females at the conference center, there were no significant relationship between age and number of activities performed (see Table 41). At the conference center, however, for males, there was a significant relationship ($p < .05$) between age and number of activities performed. The other relatively strong correlation involved females at the sports arena ($r = .2408$) and had a significance level close to .05, though exceeded it. All of this suggests that, in certain circumstances, as a person gets older they perform a greater number of activities. The scattergrams confirm this positive relationship (see Appendix B). The low coefficients of determination (r^2), however, show that age is not a good predictor of the number of activities performed in the restroom. The null hypothesis was retained in all cases, except for males at the conference center.

Table 41

Product-Moment Correlations Between Age and Number of Activities Performed in the Restroom by Males and Females at the Four Restroom Sites

Subjects	r	r2	p
Airport			
Males (N = 53)	-.0031 (p = .982)	.000	NS
Females (N = 54)	.0460 (p = .741)	.002	NS
Rest Area			
Males (N = 56)	-.0224 (p = .870)	.000	NS
Females (N = 54)	-.1089 (p = .433)	.011	NS
Sports Arena			
Males (N = 51)	.0235 (p = .870)	.000	NS
Females (N = 56)	.2408 (p = .074)	.057	NS
Conference Center			
Males (N = 58)	.2885 (p = .028)	.083	<.05
Females (N = 52)	.0400 (p = .778)	.001	NS

Ho8. The differences between the four sites and the amount of time spent in the restroom by males and females were tested using one-way analysis of variance. For females there were no differences between sites and the amount of time spent in the restroom (see Table 44). For males, however, the amount of time spent in the restroom did vary by site. There were significant differences between the sports arena (mean = 83.6 seconds) and two of the remaining three sites--the rest area (mean = 108.6 seconds), and the airport (mean = 112.5 seconds) (see Tables 42 and 43). The null hypothesis was retained for females at all four sites, and for males at the conference center. Because of the uneven number of subjects in the groups, a Bartlett Box F test was used to test within cell variances. The test yielded a test statistic of 6.926 ($p < .001$), indicating homogeneity of variances.

Ho9. The differences between the four sites and the number of activities performed in the restroom by males and females were tested using one-way analysis of variance. For females, the sports arena (mean = 3.6 activities) was significantly different from two of the remaining three sites--the conference center (mean = 4.2 activities) and

Table 42

ANOVA Summary Table for the Amount of Time Spent in the Restroom by Males by Site

Source	df	Sum of Squares	Mean Squares	F Ratio	F Prob
Between groups	3	30357.0	10119.0	3.0323	.0301
Within groups	226	754180.1	3337.1		
Total	229	784537.1			

Table 43

Results of Duncan's New Multiple Range Test of the Amount of Time (Seconds) Spent in the Restroom by Males for the Four Restroom Sites

Site	Sports Arena	Conference Center	Rest Area	Airport
	(N = 54)	(N = 63)	(N = 56)	(N = 57)
Mean	83.6	93.3	108.6	112.5

Table 44

ANOVA Summary Table for the Amount of Time Spent in the Restroom by Females by Site

Source	df	Sum of Squares	Mean Squares	F Ratio	F Prob
Between groups	3	27220.4	9073.5	1.28	.2817
Within groups	220	1558142.3	7082.5		
Total	223	1585362.7			

Group Means:

Group	Count	Mean
Airport	55	175.3
Rest Area	58	180.6
Sports Arena	58	152.5
Conference Center	53	163.5
Total	224	168.0

the airport (mean = 4.5 activities) (see Tables 47 and 48). Males followed a similar pattern, with the sports arena (mean = 2.7 activities) being significantly different from the other three sites--the airport (mean = 3.7 activities), the rest area (mean = 3.7 activities), and the conference center (mean = 4.2 activities) (see Tables 45 and 46). The null hypothesis was retained for females at the rest area. Because of the uneven number of subjects in the groups, a Bartlett Box F test was used to test within cell variances. The test yielded a test statistic of 1.239 ($p = .294$), indicating nonhomogeneity of variances. A consultation with the statistician followed. The recommendation was that even though the groups were not equal in number of subjects, they were close enough, and the test for homogeneity of variances was not necessary.

Ho10. Eight independent sample t-tests were used to determine the differences in time spent in the restroom during peak and nonpeak periods by males and females at the four sites. There were no significant differences for males or females between peak and nonpeak periods in the amount of time spent in the restroom at any of the four sites (see Table 49). The null hypothesis was retained in all cases. Since there were uneven numbers of subjects in the groups, the assumption of equal variances was tested.

Table 45

ANOVA Summary Table for the Number of Activities Performed in the Restroom by Males by Site

Source	df	Sum of Squares	Mean Squares	F Ratio	F Prob
Between groups	3	66.7	22.2	9.5366	.0000
Within groups	226	526.5	2.3		
Total	229	593.2			

Table 46

Results of Duncan's New Multiple Range Test of the Number of Activities Performed in the Restroom by Males for the Four Restroom Sites

Site	Sports Arena	Airport	Rest Area	Conference Center
	(N = 54)	(N = 57)	(N = 56)	(N = 63)
Mean	2.7	3.7	3.7	4.2

Table 47

ANOVA Summary Table for the Number of Activities Performed in the Restroom by Females by Site

Source	df	Sum of Squares	Mean Squares	F Ratio	F Prob
Between groups	3	26.3	8.8	3.6262	.0138
Within groups	220	531.9	2.4		
Total	223	558.2			

Table 48

Results of Duncan's New Multiple Range Test of the Number of Activities Performed in the Restroom by Females for the Four Restroom Sites

Site	Sports Arena	Rest Area	Conference Center	Airport
	(N = 58)	(N = 58)	(N = 53)	(N = 55)
Mean	3.6	3.9	4.2	4.5

Table 49

Differences in Mean Time Spent in the Restroom During Peak and Nonpeak Periods by Males and Females at the Four Restroom Sites

Time of Day	N	M	SD	t	p
Airport/Males					
Peak	20	97.2	52.8	-1.27	NS
Nonpeak	37	120.7	87.2		
Airport/Females					
Peak	19	175.1	113.8	-0.01	NS
Nonpeak	36	175.4	69.0		
Rest Area/Males					
Peak	33	109.8	43.6	0.23	NS
Nonpeak	23	107.0	46.9		
Rest Area/Females					
Peak	25	189.9	63.6	1.14	NS
Nonpeak	33	175.6	46.1		
Sports Arena/Males					
Peak	23	86.0	42.6	0.24	NS
Nonpeak	31	81.8	85.1		
Sports Arena/Females					
Peak	14	164.7	73.7	0.58	NS
Nonpeak	44	148.6	94.9		
Conference Center/Males					
Peak	7	110.5	29.2	1.66	NS
Nonpeak	56	91.2	29.1		
Conference Center/Females					
Peak	3	283.6	110.4	1.95	NS
Nonpeak	50	156.3	96.8		

Ho11. Eight independent sample t-tests were used to determine the differences in the number of activities performed in the restroom during peak and nonpeak periods by males and females at the four sites. There were no significant differences for males or females between peak and nonpeak periods in the number of activities performed in the restroom at any of the four sites (see Table 50). The null hypothesis was retained in all cases. Since there were uneven numbers of subjects in the the groups, the assumption of equal variances was tested.

Summary and Discussion

At all four sites, females spent more time in the restroom than males. This concurs with a finding by Henning (1977) that males spend an average of 117 seconds in the restroom, while females spend an average of 185 seconds. At two of the sites, airport and sports arena, females, performed more activities than males. The mean number of activities for females at these two sites were in keeping with the other two sites, so in actuality, men performed a fewer number of activities, thus accounting for the differences. At all four sites, there was no significant relationship between age and the amount of time spent in the restroom, for either males or females.

Table 50

Differences in Mean Number of Activities Performed in the Restroom During Peak and Nonpeak Periods by Males and Females at the Four Restroom Sites

Time of Day	N	M	SD	t	p
Airport/Males					
Peak	20	3.5	1.4	-0.60	NS
Nonpeak	37	3.7	1.4		
Airport/Females					
Peak	19	4.5	1.9	0.05	NS
Nonpeak	36	4.5	1.6		
Rest Area/Males					
Peak	33	3.9	1.4	0.96	NS
Nonpeak	23	3.5	1.4		
Rest Area/Females					
Peak	25	3.7	1.3	-1.03	NS
Nonpeak	33	4.1	1.6		
Sports Arena/Males					
Peak	23	3.0	1.6	1.45	NS
Nonpeak	31	2.5	1.2		
Sports Arena/Females					
Peak	14	3.9	.9	1.08	NS
Nonpeak	44	3.5	1.5		
Conference Center/Males					
Peak	7	4.7	2.1	0.76	NS
Nonpeak	56	4.2	1.8		
Conference Center/Females					
Peak	3	4.3	1.5	0.11	NS
Nonpeak	50	4.2	1.7		

Results from two of the sites suggest that as people get older they tend to spend more time in the restroom. With regard to elimination fixtures, none of the sites had restrooms which had elimination fixtures in the proportions indicated by Hypothesis 5. Females need a greater number of elimination fixtures than do males. This supports the conclusion by Henning and Pauls (1974) that the fixture requirements for restrooms in theatre complexes in Canada, for females to have twice as many fixtures as males may be the correct proportion. This can be attributed to females taking longer to use the elimination fixtures, even though a larger percentage of the restroom users were male. No clear pattern emerged with regard to explaining the relationship between the amount of time spent in the restroom and the number of activities performed. There was a significant relationship between these two variables for females at the airport and sports arena, and for males at the rest area. There was a relationship between age and number of activities performed only for males at the conference center. Also, for males only, there were differences between all four sites and the amount of time spent in the restroom. In addition, for males, there were differences between the number of activities performed and the site, with the differences being between the sports arena and the remaining three

sites--airport, rest area, and conference center, with there being fewer activities performed in the restroom at the sports arena. For females there were also differences between three sites, the sports arena, airport, and conference center in the number of activities performed. Just as for males, for females, fewer activities were performed at the sports arena. For both males and females, at all four sites, peak and nonpeak periods made no difference in the amount of time spent in the restroom or number of activities performed.

The only consistant finding for all four sites is that females spend more time in the restroom than males. This indicates an apparent need for women's restrooms to have a greater number of elimination fixtures than men's restrooms. The majority of the findings were not consistant across all four sites, indicating that: (1) number of activities; (2) time spent in the restroom (for males); (3) effects of age on time spent in the restroom; (4) effects of age on number of activities performed in the restroom; (5) the likelihood of having to stand in line; and (6) time spent in the restroom as related to number of activities performed--are all site specific. The exception is that time spent by females in the restroom was not site dependent. Their average time

spent in the restroom is approximately the same regardless of site.

Since the majority of these findings are site specific, the need to carefully research and analyze each type of building/facility prior to specifying restroom fixtures is apparent. Correctly specifying restroom fixtures is especially important since restrooms are considered inflexible, permanent, and not easily changed or adjusted.

Chapter 6

SUMMARY, CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS FOR FURTHER RESEARCH

A summary of the study is presented in this chapter. Conclusions drawn from the findings are also presented, along with the implications of the study. Finally, recommendations for further research are proposed.

Summary

Women often experience having to stand in line in order to use public restrooms. There is a growing awareness of the problem of elimination fixture inequity in women's restrooms. At least two state legislatures, California and Virginia, have taken action to increase the number of elimination fixtures in public restrooms for women.

The objectives of the study were to (1) determine the relationship between the amount of time spent in the restroom and gender of the user; (2) determine whether women's restrooms accommodate user needs and demands as well as men's restrooms; (3) determine the difference between males and females and the types of activities performed in the restroom; (4) determine the difference

between male and female aggregates of activities performed in public restrooms; (5) determine the average number of activities performed in the restroom by males and females; (6) determine the relationship between the amount of time spent in the restroom and the number of activities performed; (7) determine the relationship between the amount of time spent in the restroom and the age of the user; (8) determine the relationship between age and number of activities performed; (9) determine the relationship between the amount of time spent in the restroom and the type of building/facility; (10) determine the relationship between building/facility type and the number of activities performed; (11) determine the types of activities performed at various building/facility types; (12) make recommendations for changes in model plumbing codes in order to accommodate users and their demands more adequately; and (13) evaluate the methodology of the study and to make recommendations for improvement of methodology for further study.

Based on a set of established criteria, four sites were selected--an airport, a highway rest area, a sports arena, and a conference center. A systematic random sample was drawn from male and female restroom users at each site. Minors were excluded from the study. A one-page self-administered questionnaire was developed which sought

the following information: (1) the amount of time the respondent spent in the restroom; (2) the gender of the respondent; (3) the age of the respondent; (4) whether or not the respondent had a mobility handicap; (5) whether it was a peak or nonpeak period at the building/facility; (6) whether it was morning (AM) or afternoon/evening (PM); (7) whether or not the respondent had to stand in line; (8) the amount of time spent in line; (9) the types and number of activities performed by the respondent; (10) the most time-consuming activity performed by the respondent; (11) what the respondent liked most about the restroom; (12) what the respondent thought would improve the restroom; (13) which eliminatiion fixture(s) were used; and (14) the respondent's aggregate of activities performed in the restroom.

A small pilot study was conducted at an on-campus building at Virginia Tech to test the methodology and instruments. Observations made during the pilot study were discussed, investigated, and corrected as necessary.

For the larger study, data were collected during both periods of continual level of demand (nonpeak) and concentrated periods of heavy demand (peak). Those persons in the sample were timed and then asked to complete a questionnaire as they exited the restroom. The sample used in this study consisted of 230 male and 224 female

respondents (approximately 50 persons of each gender at each of the four sites). For both male and female nonrespondents, lack of time was given as the major reason for not completing a questionnaire at three of the four sites--airport, rest area, and conference center, and for females at the sports arena. A majority of males at the sports arena gave no reason for refusing. The majority of both male and female respondents at all four sites, performed from two to five activities. The number of activities performed ranged from one to nine. The mean number of activities for males ranged from 2.72 (sports arena) to 4.22 (conference center). For females, the means ranged from 3.59 (sports arena) to 4.51 (airport). Urination, washing hands, and checking appearance were the three activities performed most frequently for both males and females, at three of the four sites--airport, rest area, and sports arena, and for males at the conference center. The exception was females at the conference center, who performed these same three activities, but in reverse order of frequency--check appearance, wash hands, and urinate. The two major aggregates of activities were (1) urinate--wash hands--check appearance and (2) urinate--wash hands. Both males and females reported having to stand in line at three of the four sites--rest area, sports arena, and conference center. But, at the sports arena and

conference center, a greater percentage of females had to stand in line. For both males and females, waits were usually fewer than five minutes. Consistantly, across all four sites, males used the elimination fixtures in the following ratio, two-thirds used the urinal, while one-third used the regular stall. The majority of females at all four sites reported using the regular stall. For both males and femlaes, at all four sites, the most-liked features included availability/ relief, cleanliness, and paper towels. Suggestions for restroom improvement were more site specific, but included cleaning and more paper towels.

Females, at all four sites, spent more time in the restroom than males, on an average. At two of the sites, airport and sports arena, females, on an average, performed more activities than males. At all four sites, there was no significant relationship between age and the amount of time spent in the restroom, for either males or females. The results from two of the sites, however, showed a slight trend toward older people spending more time in the restroom. With regard to elimination fixtures, none of the sites had restrooms which had elimination fixtures in the proportions indicated by Hypothesis 5. There was no clear pattern with regard to explaining the relationship between the amount of time spent in the restroom and the number of

activities performed. There was a significant relationship between these two variables for females at the airport and sports arena, and for males at the rest area. There was a significant relationship between age and number of activities performed only for males at the conference center. Also for males only, there were significant differences between all four sites and the amount of time spent in the restroom. In addition, for males, there were significant differences between the number of activities performed and the site, with the differences being between the sports arena and the remaining three sites--airport, rest area, and conference center, with fewer activities being performed at the sports arena. For females there were also significant differences between three sites, the sports arena, airport, and conference center, in the number of activities performed. Just as for males, for females, fewer activities were performed at the sports arena. For both males and females, at all four sites, peak and nonpeak periods made no significant difference in the amount of time spent in the restroom or number of activities performed.

Conclusions

On the basis of this study, the following conclusions regarding types and numbers of activities performed in the restroom and the amount of time spent in the restroom by males and females, appear justified.

1. Females, on an average, spend more time in the restroom than males.

2. The mean time spent in the restroom by females does not vary by site, but does vary by site for males.

3. The mean number of activities performed in the restroom varied by site for both genders.

4. As people get older, they tend to spend more time in the restroom.

5. Age is not a factor with regard to number of activities performed in the restroom.

6. Whether number of activities performed in the restroom affects time spent in the restroom, varies by site and gender.

7. Females need more elimination fixtures than males, but just how many more varies by site.

8. Females have to stand in line more often than males.

9. Males and females perform a similar number of activities while in the restroom.

10. Males and females perform similar types of activities while in the restroom.

11. Males and females perform similar agregates of activities in the restroom.

12. For males and females, urination was the most time-consuming activity, followed by hand washing.

13. Males most often use the urinal. The ratio of urinals to water closets for males should be two-thirds to one-third.

14. Restrooms, for both genders, should be readily available/easily accessible, clean, and have an adequate supply of paper towels.

Implications

Females spend a greater amount of time in the restroom than males. Since the number and types of activities are very similar for both males and females, this indicates

that women are indeed slower than males in their performance of specific activities, especially that of urination. This can probably be attributed to clothing management problems, the cleanliness and maintenance condition of the stall, and the problem of where to place items, such a purse, briefcase, or packages while in the stall. Males use the urinal more often than water closets for the purpose of urination. Use of the urinal requires only a minimum of clothing adjustment, while a briefcase and newspaper can be held under an arm during urination, making this activity less time-consuming for males than females (Kira, 1976). Providing a greater number of elimination fixtures in women's restrooms so that females may take the time they need and have the restroom accommodate the required number of users may be the best solution. The cost of requiring additional elimination fixtures remains an important issue. Requiring more stalls means not only more water closets, but more restroom floor space resulting in less floor space for other aspects of the building/facility. This is not only an issue of capital outlay, but also one of loss of revenue. One additional stall could mean one less revenue producing table in a restaurant, for example.

The implications of this study, and related studies, suggest the following recommendations for the designers of

public restrooms, those involved with the establishment of plumbing codes, and the owners and managers of buildings and facilities.

Model Code Groups. Model code groups and others involved with the establishment of plumbing codes should

(1) Reevaluate minimum plumbing fixture requirements, especially as they apply to females, and acknowledge that there is a need to increase the numbers of elimination fixtures for females;

(2) Hold public hearings to examine fixture inequities and possible solutions to the problem;

(3) Fund research projects in order to provide data for use in the hearings, upon which to base recommendations;

(4) Change the plumbing codes so that women's restrooms would have an adequate number of elimination fixtures to meet user needs and demand;

(5) Consider the adoption of performance standards to replace specification standards. A performance standard for a restroom would state that the restroom has to service a certain number of users

during a given time period. A specification standard for a restroom, on the other hand, would specify a number of fixtures for a given number of users.

Designers. All of the design professions, including architects, interior designers, and engineers, involved with public restroom design should

(1) Carry out extensive programming on restrooms in buildings/facilities similar to those they are designing, prior to designing the restrooms, since many of the findings of this study were site specific;

(2) Recognize minimum fixture requirements for what they are, minimum requirements, and not necessarily the actual number needed;

(3) Not consider cost to be the major deciding factor in how many fixtures and features to install;

(4) Look beyond water closets, urinals, and sinks as the only necessary items in a restroom. Thought should be given to how the restroom is used as an indication of which features should be installed, such as shelves and hooks in the stalls, shelves

near the sinks, proper lighting, and some form of seating;

(5) Create a restroom design which is flexible enough to allow additions and deletions of fixtures, so that retrofiting would be less expensive than it is currently.

Public Health Officials. Public health officials should

(1) Lobby codes groups to bring about an increase in the number of elimination fixtures for females because of the health implications involved;

(2) Provide information to the public concerning the high incidence of urinary tract infections in females and how these are related to infrequent voiding. In this way, the public will become aware of the need for an adequate number of restroom elimination fixtures for females.

Owners and Managers. Owners and managers of various buildings and facilities should

(1) Recognize the importance of restrooms within the general scheme of the building/facility and the problems that may occur;

(2) Understand the types and numbers of activities performed in the restroom and the amount of time spent in the restroom, by males and females, and how these factors affect the management of the facility. Examples include the scheduling of breaks at conferences or the determination of the length of intermission at at theater;

(3) Be willing to spend money in order to have restrooms designed and built which adequately meet user needs and demands;

(4) Cooperate with researchers in making the facility available for study as the findings will be beneficial to them.

Recommendations for Further Research

The following recommendations are made for further research in the area of public restroom design, including recommendations for improving the methodology of the study.

(1) Self-administered questionnaires should be replaced by observers from within the restroom, in order to obtain more accurate information;

(2) Individual activities should be timed and obervations made and recorded;

(3) Digital stopwatches should be used for speed and accuracy;

(4) Additional types of sites should be studied;

(5) The study should be replicated at other airports, rest areas, sports arenas, and conference centers, in order to see if the results would be the same;

(6) Male and female models should be used to research how clothing management problems, cleanliness and maintenance condition of the restroom, use of a paper funnel (females only), being a member of a special user group (pregnant, handicapped, elderly, or obese), carrying items, and types of activities performed affect the amount of time spent in the water closet;

(7) The queuing theory aspect of the study should be pursued and a formula developed for estimating elimination fixture requirements;

(8) Regional differences in restroom use and time spent in the restroom should be examined;

(9) The restroom use of minors, including the amount of time spent in the restroom, should be studied;

(10) The restroom use of the elderly (those 65 years of age or older), including the amount of time spent in the restroom, should be studied;

(11) The effects of pay toilets on the amount of time spent in the restroom should be examined.

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Appendices

Appendix A

Questionnaires

Male AM PM H: Y N Time:_____

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Public Restroom Study

Did you have to wait in line to use the restroom?
(check one) _____YES _____NO

If yes, please estimate the time you waited in line (check one)

_____ More than 5 minutes

_____ 1 to 5 minutes

_____ Less than 1 minute

Please check all of the activities you performed while you were in the restroom.

_____ Wash hands
_____ Check appearance
_____ Comb/brush hair
_____ Straighten clothes
_____ Straighten tie
_____ Change clothes
_____ Wash face
_____ Brush/floss teeth
_____ Urinate
_____ Deficate (bowel movement)
_____ Put in/take out contacts
_____ Clean glasses
_____ Take medicine
_____ Smoke
_____ Talk
_____ Wait on other person
_____ Change diaper
_____ Assist child/children
_____ Other (please specify, _____)
_____ Other (please specify, _____)

Which activity do you believe took the most time?

_____

Did you use (place a check by your answer):

the regular stall?	_____ YES	_____ NO
the handicapped stall?	_____ YES	_____ NO
the urinal?	_____ YES	_____ NO

What did you like most about the restroom?

_____

What do you think would have improved the restroom?

_____

Year of birth:_____

Thank you for your time and cooperation.

Female AM PM H: Y N Time:_____

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Public Restroom Study

Did you have to wait in line to use the restroom?
(check one) _____YES _____NO

If yes, please estimate the time you waited in line
(check one)

_____ More than 5 minutes

_____ 1 to 5 minutes

_____ Less than 1 minute

Please check all of the activities you performed while you were in the restroom.

_____ Wash hands
_____ Check appearance
_____ Comb/brush hair
_____ Straighten clothes
_____ Adjust jewelry/scarf
_____ Change clothes
_____ Wash face
_____ Apply make-up
_____ Brush/floss teeth
_____ Urinate
_____ Deficate (bowel movement)
_____ Feminine hygiene
_____ Put in/take out contacts
_____ Clean glasses
_____ Take medicine
_____ Smoke
_____ Talk
_____ Wait on other person
_____ Change diaper
_____ Nurse baby
_____ Assist child/children
_____ Other (please specify, _____)
_____ Other (please specify, _____)

Which activity do you believe took the most time?

_____

Did you use (place a check by your answer):
the regular stall? _____ YES _____ NO
the handicapped stall? _____ YES _____ NO

What did you like most about the restroom?

_____

What do you think would have improved the restroom?

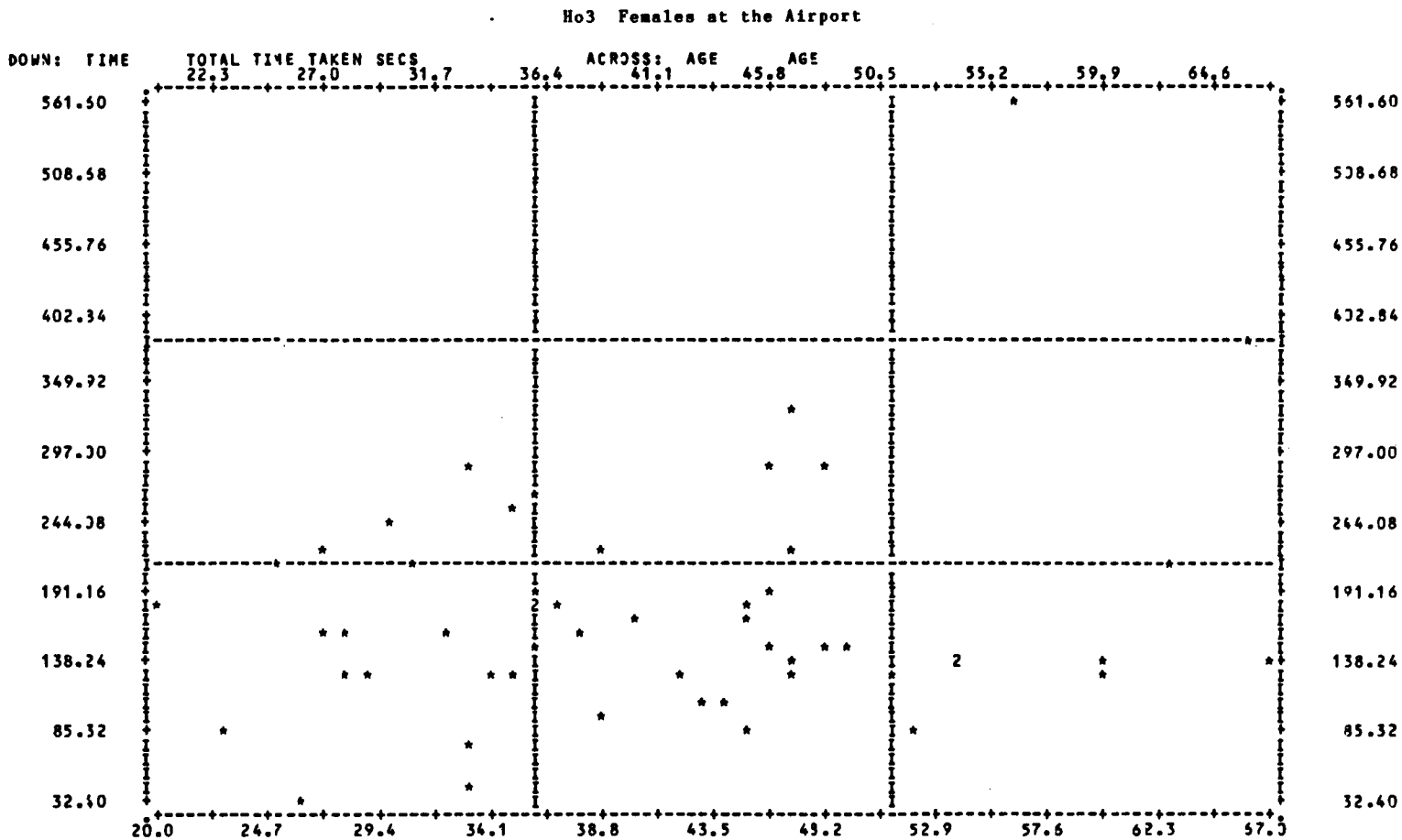
_____

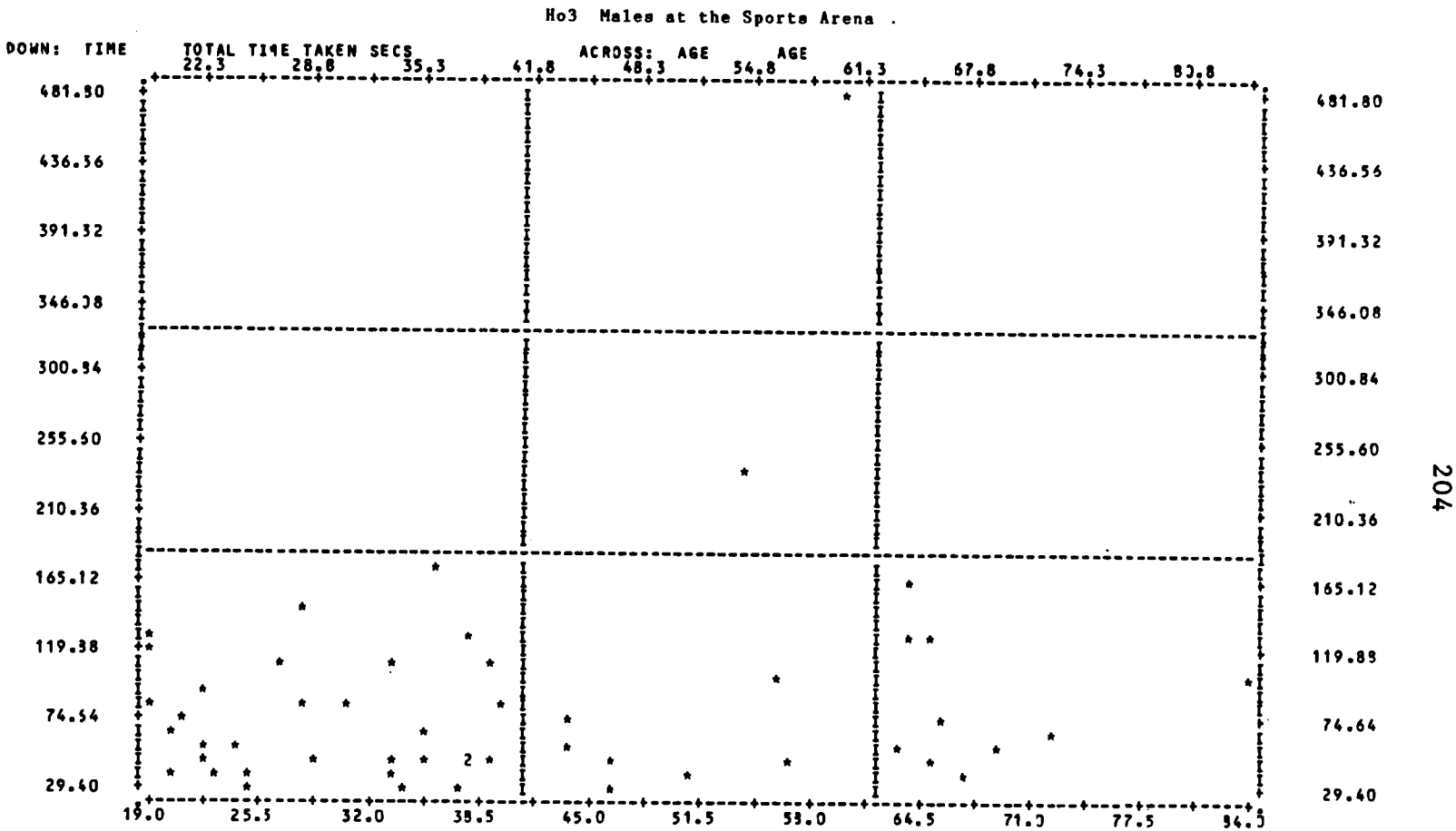
Year of birth:_____

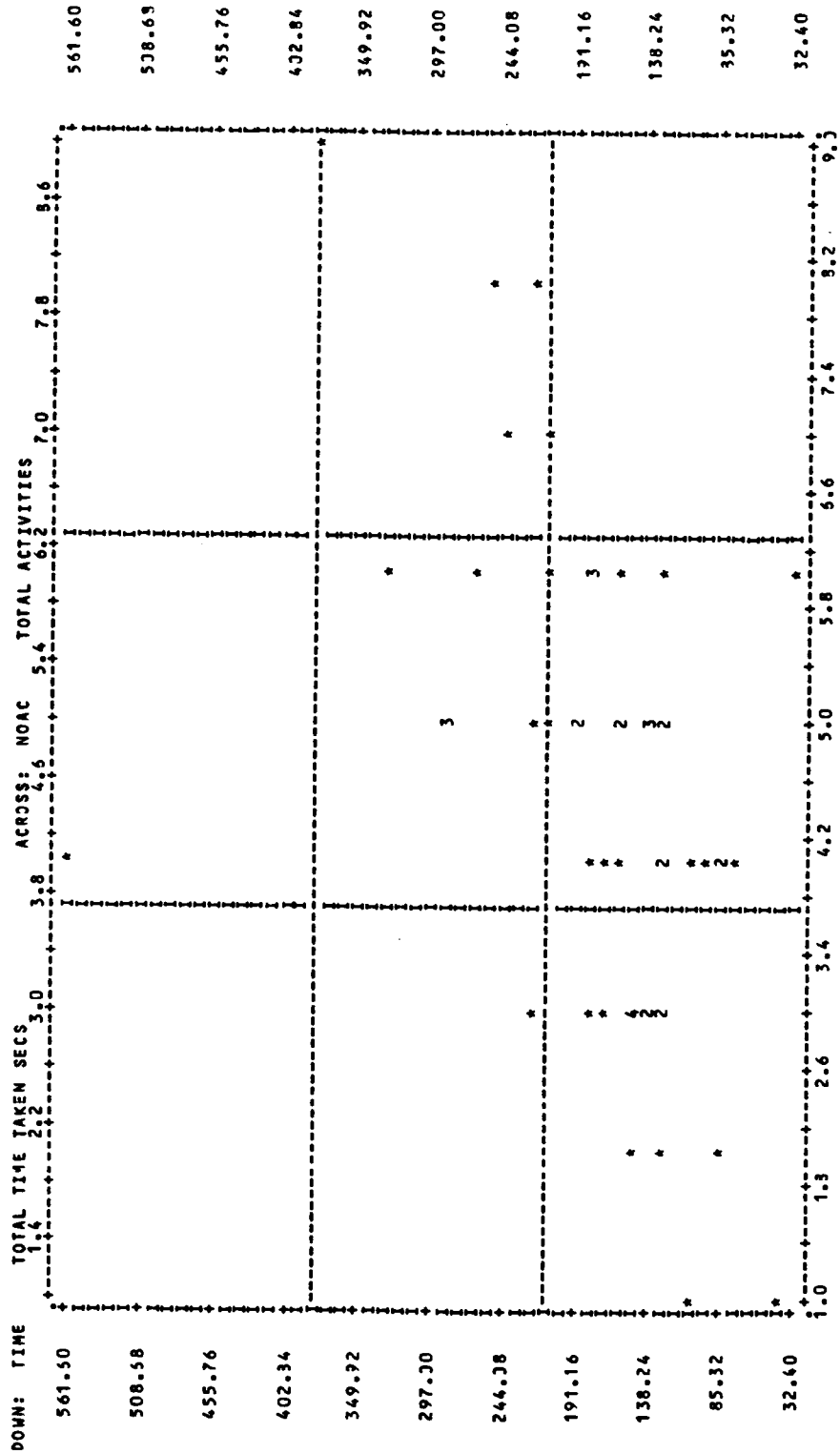
Thank you for your time and cooperation.

Appendix B

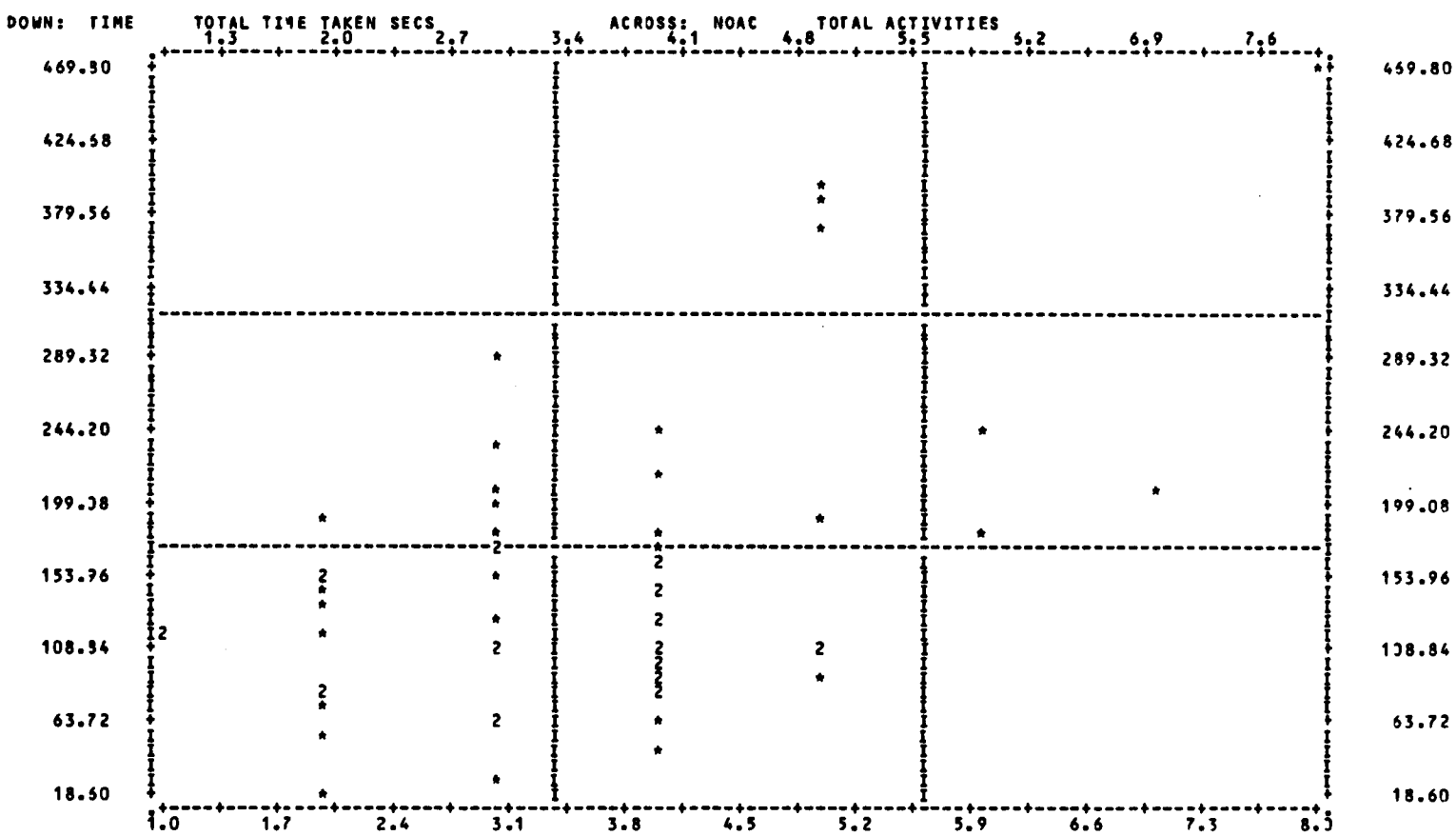
Scattergrams

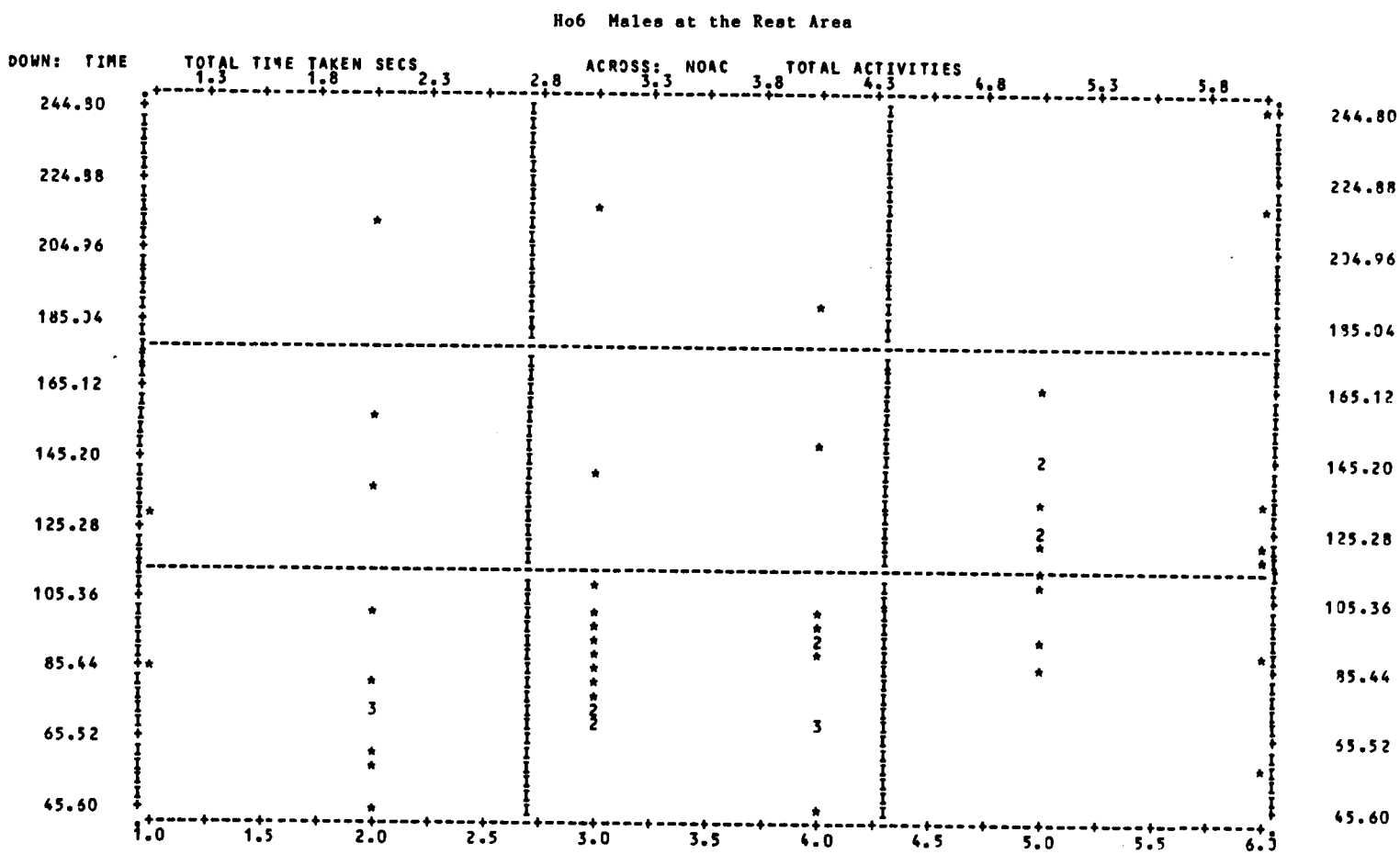

Ho3 Females at the Airport
DOWN: TIME
TOTAL TIME TAKEN SECS
ACROSS: AGE
AGE
22.3
27.0
31.7
36.4
41.1
45.8
50.5
55.2
59.9
64.6
561.60
508.68
455.76
402.84
349.92
297.00
244.08
191.16
138.24
85.32
32.40
20.0
24.7
29.4
34.1
38.8
43.5
48.2
52.9
57.6
62.3
67.0

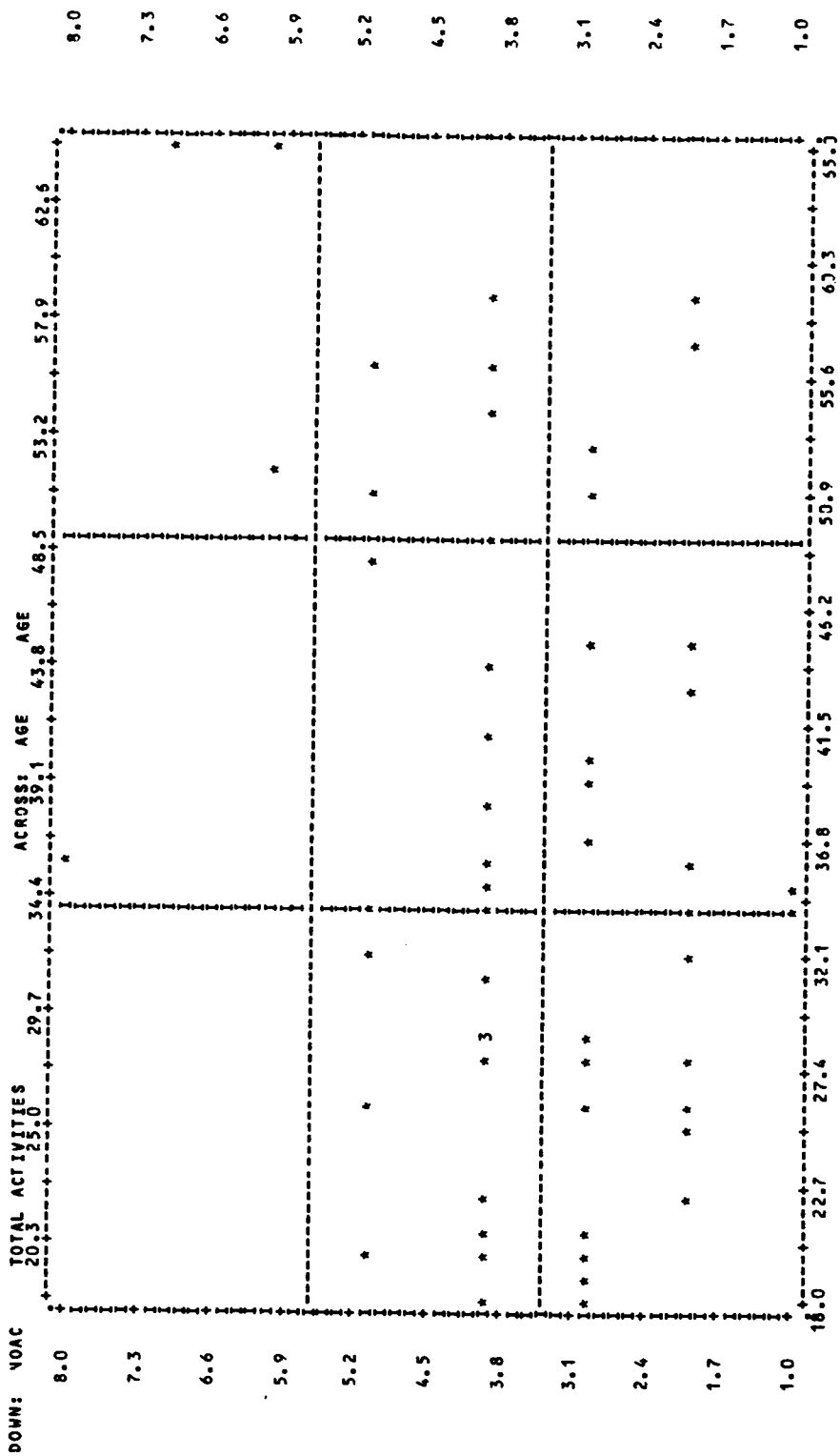

Ho3 Males at the Sports Arena .
DOWN: TIME
TOTAL TIME TAKEN SECS
ACROSS: AGE AGE
22.3 28.8 35.3 41.8 48.3 54.8 61.3 67.8 74.3 80.8
481.80
436.56
391.32
346.08
300.84
255.60
210.36
165.12
119.88
74.64
29.40
19.0 25.5 32.0 38.5 45.0 51.5 58.0 64.5 71.0 77.5 84.5

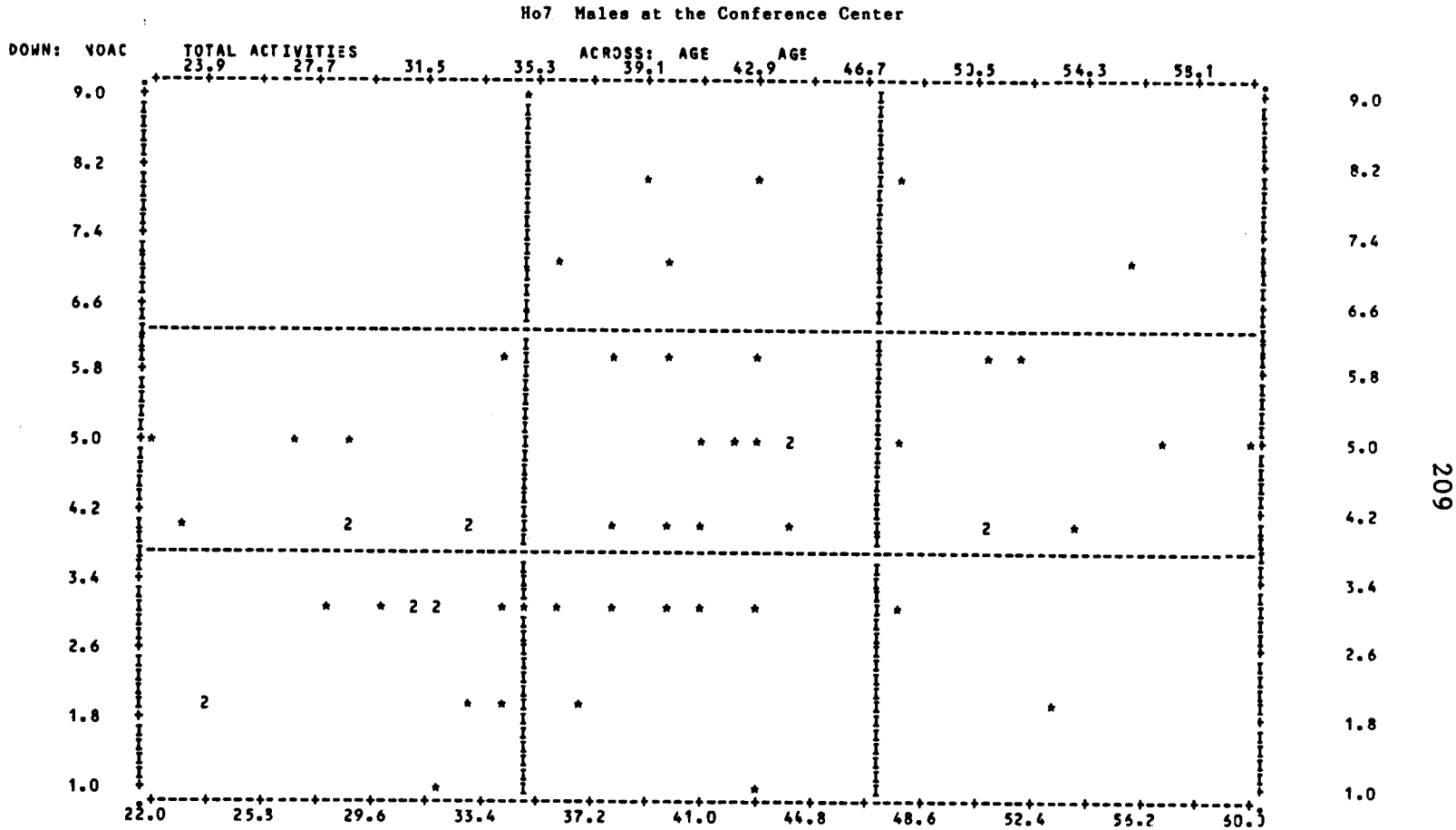

Ho6 Females at the Airport
DOWN: TIME
TOTAL TIME TAKEN SECS
ACROSS: NOAC TOTAL ACTIVITIES
561.50
508.58
455.76
402.34
349.92
297.30
244.38
191.16
138.24
85.32
32.40
561.60
508.68
455.76
402.84
349.92
297.00
244.08
191.16
138.24
85.32
32.40

Ho6 Females at the Sports Arena




Ho6 Males at the Rest Area
DOWN: TIME
TOTAL TIME TAKEN SECS
ACROSS: NOAC
TOTAL ACTIVITIES
1.3
1.8
2.3
2.8
3.3
3.8
4.3
4.8
5.3
5.8
244.80
224.88
204.96
185.04
165.12
145.20
125.28
105.36
85.44
65.52
45.60
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0


Ho7 Females at the Sports Arena
DOWN: VOAC
ACROSS: AGE
AGE
TOTAL ACTIVITIES
20.3
25.0
29.7
34.4
39.1
43.8
48.5
53.2
57.9
62.6
8.0
7.3
6.6
5.9
5.2
4.5
3.8
3.1
2.4
1.7
1.0
18.0
22.7
27.4
32.1
36.8
41.5
45.2
50.9
55.6
60.3
55.3


Ho7 Males at the Conference Center
DOWN: VOAC TOTAL ACTIVITIES
ACROSS: AGE AGE
23.9
27.7
31.5
35.3
39.1
42.9
46.7
50.5
54.3
58.1
9.0
8.2
7.4
6.6
5.8
5.0
4.2
3.4
2.6
1.8
1.0
22.0
25.8
29.6
33.4
37.2
41.0
44.8
48.6
52.4
56.2
60.0

The vita has been removed from the scanned document