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Estimation of Number of Toilets Requirement in Public Places

by

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A THESIS

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ABSTRACT

In this dissertation determination of number of toilets in public places is studied in different types of location of public places such as bus terminals, school/college, and hospitals. This software was developed which can project the number of toilets in different public location as required by the user by providing the simple data asked by the program. This software was developed with the help of Microsoft Visual Studio which is an advance windows software development tool. In the Microsoft Visual Studio, environment of Vb.NET was followed.

This study was carried out in bus terminals, hospital and school/college from which peak hour for defecator and Urinates on these location were found out. Also peak factor in this hour was calculated. Time for urinating separately for male and female was also calculated from the collected data. In this study time for urinating male was found to be 30 seconds and for female was 50 seconds whereas defecating time for male and female was 7 minute. Different peak factor according to location was found. For bus terminal with respect to defecator male peak factor was found to be 1.35 and for female was 1.18 and in case of urinates 1.34 was for male and 1.43 was for female. For hospital with respect to defecator male peak factor was 2.23 and for female was 2.24 and in case of urinates 1.86 was for male and 1.84 was for female.

With the help of program developed number of toilet required for the survey location Koteshwor public toilets were 6 urinals for male and existing were 5, 4 water closets for male and existing were 5, and 6 water closets for female whereas existing werw 6 in this case. And for Pulchowk college, F- Block required number of urinals were 28 and existing were 31, which is enough numbers, required number of water closets form the program and existing both were 3 and in case of female water closets required number from program were 8 but the existing number of toilets were only 2.

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LIST OF ABBREVIATIONS

BF	Bed Factor
CF	Crowd Factor
DF	Distance Factor
GUI	Graphical User Interface
NOB	Number of Bed
NFS	Number of Female Student
NM S	Number of Male Student
NMU	Number of Male Urinals
PH	Peak Hour
PF	Peak Factor
SF	Student Factor
TF	Time Factor
VB	Visual Basic
WCM	Water Closet Male
WCF	Water Closet Female

CHAPTER ONE

1.0 INTRODUCTION

1.1 General Background

For the residents of the Kathmandu Valley, every long tour outside their home necessitates a visit to a toilet. In case nature calls while on the streets of Kathmandu, the choices are either a visit to some rotten, ammonia-filled, tear-inducing public toilet or bushes. However, even these toilets are few and far between.

The valley, an urban centre of millions, has only 68 public toilets of which only 61 are useable, according to a study, 'Public toilets in the Kathmandu valley,' conducted by Mamata Sayami. This breaks down to one public bathroom for every 65000 residents. Furthermore, out of the 61, only 43 have running water. None of the bathrooms are disabled friendly and had no special provisions for women and children. Thus, people are often forced to return to their home, visit restrooms in shopping malls or restaurants or often, urinate and defecate in public, behind trees and in alleyways (www.republica.com).

In an effort to improve the urban environment and provide access to sanitation facilities to Kathmandu residents, the government has plans to build public toilets in busy areas. To meet sanitation demand a public-private partnership is needed. Despite the government's claim to meet universal sanitation targets by 2017, people are still deprived of basic sanitation facilities in Nepal.

The provision of public toilet is enlisted in Nepal National Building Code for different types of buildings, hotels, school/college, cinemas etc., (NBC 208 : 2003) under the heading 'Sanitary and Plumbing Design Requirement'. In this code provision are provided in the table for the different types of building and factories but not for the public places like city junction, parks, bus stand etc. Provided provision also seems to be unreliable because the number of toilets for male and female do not resemble the logical proportion.

Another reason for requirement of revision is that there is no toilet provisioning for disabled and elderly person, which must be considered according to universal sanitation principle. This code is mainly focused on commercial places like bus terminals, school/college and hospitals.

While government effort have long concentrated on providing access to basic sanitation facilities to the rural population, the urban areas have gone neglected. In an effort to meet the universal target of total sanitation for all by 2017, government and partner organizations, including donors, have focused on rural communities by launching drives against open defecation. However, urban area, like Kathmandu, are also facing problems on sanitation facilities.

1.2 Rationale

The study is to determine the number of toilets in public places with logical programming. At present, most toilet standards are inadequate. Greater attention needs to be given to the social aspects of toilet provision and to the urban planning context of toilet location and siting. Social changes such as increased mobility, tourism and affluence have all resulted in a new toilet agenda, as everyone needs toilet when away from home for the day. Demands of equality have highlighted the inadequate levels of provision for women, compared to men. The requirements of people with disabilities, and an ageing people, have led to the reappraisal of toilet provision and design consideration.

This has led to a questioning to the current condition of public toilets for the population as a whole. Building better toilet is only half the battle, they need to be maintained and managed effectively.

1.3 Objectives of the Study

The main objective of this study is to develop the acceptable software to find out the number of toilets in the public places like bus terminal, hospitals and school/college. Due to the variation of time for male and female to urinate, there is the variation of required number of urinals for same number of male and female, so it is also considered while developing the code. The number of urinals and defecating pans for male and female will be found out separately. The specific objective can be point out as:

- to estimate the number of toilets required in public places for bus terminals, hospital and school/college
- to calculate number of urinals and defecating pans separately for male and female

1.4 Limitations of the Study

Some public places like bus park may require large doors and space inside the toilets because people may come with luggage and bags, but these factor were not considered. Also there is a demand of toilets for disabled and old age friendly, which were not considered. The limitations are as:

- factors such as required space and door size was not considered
- disabled and old age group people are not considered
- data after 8 P.M. were not taken in bus terminal

1.5 Organization of the Report

This report is organized into five chapters

Chapter One deals with introduction, rationale of the study, objectives of the study, and limitation of the study.

Chapter Two describes the theories and literature review, which is related with the study. It contains relevant information and data available in past research, papers, journals etc.

Chapter Three describes the methodology adopted for this research.

Chapter Four includes result obtained during the study period and discussions

Chapter Five includes conclusions and recommendation

The Annex contains sampling data and tables.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Public Toilets

Public places are those places in which public movement occurs fluently. Places like bus terminals, school/college, hospitals, theatres, office buildings etc. are considered as public places. Toilets constructed in these place are known as public toilets. These places should be provided with the sufficient numbers of toilet for the comfort of people.

Public toilets are one of the basic necessities of public life in an urban area and they indicate the sanitary condition of a city. They are an important components of a city's public service spaces. In order to provide universal access toilets within targeted year, bodies concerned authorities need to invest in urban sanitation, which is seen as the biggest challenge to the sanitation drive in the country.

Many discussions on the need of public toilets have been noticed in the local press over the years. However two goals could have been easily achieved at the same time if these public toilets shall also be made friendly and accessible to the disabled and the elderly as per recognized standards. This would have effectively and profoundly impacted the lives of persons with disabilities and the elderly (www.republica.com).

Provision like Sulabh public toilet complexes in public places and slums on 'pay-and-use basis' is an important landmark in the field of community health, hygiene and environmental sanitation. Sulabh toilet complexes are located in public places, bus stands, hospitals, markets and slums. For the construction, operation and maintenance of these complexes, sulabh plays the role of catalyst and a partner between official agencies and the user of the toilet complexes. The Sulabh complexes are operated by trained employees night and day and have separate enclosures for men and women.

The system of operation and maintenance of community toilets evolved by sulabh has proved a boon to the local bodies in their endeavor to keep the towns clean and improve environment.

Study suggests that provision like separate toilets and wash basin should be provided for each sex and for disabled persons, in case of restaurants and hotels, facilities for staff should only be used by them, especially in premises where food is handled and

where toilets are used by females, suitable means of disposing of sanitary dressing should be provided. (Canterbury City Council, 2008)

Recently in Koteshwor public toilet with the facility of bathing has been launched which seems to be running in good condition. In the name of city service centre facility of café is also provided alongside.

Reviewing Nepalese Standard it is known that only developing provision is only not sufficient unless there is the political support, financial incentive and cultural acknowledgement of the importance of public toilet.

2.2 Review of Available Standard

The public toilet should meet the healthy and hygienic condition considering the required number of toilet according to places. Also consideration should be made for women, disabled and old age people should be considered on the basis of other available standard so that changes in guideline will be suitable for all the people according to universal sanitation. In case of Nepalese standard it is included in the *Nepal National Building Code* according to types of building and users but there is no significant provision for number of toilets in public places. Some of the standards (National and International) for number of toilets according to public places are included here.

Table 2.1 Sanitary Requirements Educational Institutions

S. No.	Fitments	Boys	Girls
1	Water-closets	1 per 40 pupils or part thereof	1 per 25 pupils or part thereof
2	Ablution taps	1 in each water-closet	1 in each water-closet
3	Urinals	1 per 20 pupils or part thereof	-
4	Drinking water fountains	1 for every 50 pupils or part thereof	1 for every 50 pupils or part thereof
5	Cleaner's sink	1 per floor, Min	

(Source: NBC 208:2003)

Table 2.2 Sanitary Requirement of Hospitals, Outdoor patient wards

S. No.	Fitments	For male	For female
1	Water-closets	1 for every 100 persons or part thereof	2 for every 100 persons or part thereof
2	Ablution taps	1 in each water-close	2 in each water-close
3	Urinals	1 for every 50 persons or part thereof	-
4	Wash basins	1 for every 100 persons	2 for every 100 person

(Source: NBC 208:2003)

Table 2.3 Sanitary Requirement Hospital, Indoor patient wards

S. No.	Fitments	For Males and Females
1	Water-closets	1 for every 8 beds or part thereof
2	Ablution taps	1 in each water-closet plus one water tap with draining arrangements in the vicinity of water-closets and urinals for every 50 beds or part thereof
3	Wash basins	2 up to 30 beds; add 1 for every additional 30 beds or part thereof
4	Baths	1 bath with shower for every 8 beds or part thereof
5	Bedpan washing sinks	1 for each ward
6	Cleaner's sinks	1 for each ward

(Source: NBC 208:2003)

Table 2.4 Public Houses and Licensed bars (Britain)

S. No.	Appliances	For male customers	For female customers
1	Water Closets	1 for up to 150 males plus one for every additional 150 males or part thereof	1 for up to 12 females plus 1 for every 13 to 30 females plus 1 for every additional 25 females
2	Urinals	2 for up to 75 males plus one for every additional 75 males or part thereof	Nil

(Source: Greed, 2003)

Table 2.5 Restaurants, cafes, canteens and catering premises**(non-liquor licensed premises)**

S. No.	Appliances	For male	For female
1	Water Closets	1 per 100 up to 400 males plus 1 for every additional 250 (or part of 250) males	2 per 50 up to 200 females plus 1 for every additional 100) or part of 100) females
2	Urinal	1 per 50 males	-
3	Wash basin	1 per WC and plus 1 per 5 (or part of 5) urinals.	1 per WC
4	Cleaner's sink	Adequate provision should be made for cleaning facilities including at least one cleaner's sink	

(Source: Canterbury city council, 2008)

Table 2.6 Public Houses and Licensed Bars (Canterbury)

S. No.	Appliances	For male	For female
1	Water Closets	1 for up to 150 males plus 1 for every additional 150 (or part of 150) males.	1 for up to 12 females plus 1 to 13 to 30 females plus 1 for every additional 25 females
2	Urinal	2 for up to 75 males plus 1 for every additional 75 (or part of 75) male	-
3	Wash basin	1 per WC and in addition 1 per 5 (or part of 5) urinal	1 per 2 WCs
4	Cleaner's sink	Adequate provision should be made for cleaning facilities including at least one cleaner's sink	

(Source: Canterbury city council, 2008)

In these standard facilities like wash basin, cleaner sink's are also included, but in this study only required number of urinals for male and water closets for male and female was found out. And also the study is limited to bus terminals, hospitals and college only.

2.3 Programming Language

A programming language is a formal constructed language designed to communicate instructions to a machine, particularly a computer. Programming languages can be used to create programs to control the behavior of a machine or to express algorithms. A computer programming language is used to write computer programs, which involve a computer performing some kind of computation or algorithm and possibly control external device. Programming language is usually contain abstractions for defining and manipulating data structures or controlling the flow of execution.

For developing code to find number of toilets in public places Microsoft Visual studio software is selected for this Study. Different environment such as C++, Vb.net etc. are available under the visual studio. For this study Vb.NET environment had been chosen. Vb.NET is a general purpose programming language. It has imperative, object-oriented and graphic programming features, while also providing low-level memory manipulation. It was designed with a bias toward system programming and embedded, resource-constrained and large systems, with performance, efficiency and flexibility of use as its design highlights. Vb.NET has also been found useful in many other contexts, with key strengths being software infrastructure and resource-constrained applications, server and performance-critical applications.

Regarding the literature ‘Vb.NET’, this code has been used for different operating system, development of vast software, for analyzing data base etc. This proposed program is easy and simpler, for those who have knowledge about syntax and can generate the flow chart and finally compiling the program logically.

2.4 Factors Controlling Number of Toilets

While calculating number of toilet in specific public place there are certain factors which should be considered. These factor control the number of toilet in such places. Factor like location of toilet, crowd of the public in such places. Also equal provision for male and female should be made (Greed, 2003). Such factors are briefly explained in this section.

2.4.1 Peak hour (PH)

This is the time at which public flow may occur in the highest number in the public toilet. This time may vary according to types of places, for example this time may

occur during the office hour in bus terminal whereas this may occur during break time in school/college. Also peak hour may occur in different time for urinating and defecating. The factor by which number of people exceeded in this hour to that of average is considered as peak factor (PF).

2.4.2 Distance factor (DF)

Distance factor means where the toilet is situated in the public places. If the toilet is located where the people have easy access then there will be more public flow if not the willingness of public toward using toilets will be decrease. So the distance of the public toilets from the public reach will control the user behavior towards public toilets. Questionnaires according to distance in meter was developed and presented to the people who have knowledge on sanitary and the result was recorded. This factor is presented in Table 4.1 according to respective distance.

2.4.3 Crowd factor (CF)

Crowd factor indicates the crowd of people with respect to one place from other. The survey regarding to public places was conducted in one place and the data for other place was projected with refer to that place considering how much crowd is that place from the place where survey conducted. For example if the survey is carried out in Koteshwor public toilet then for Baneshwor toilet number can be increase by some factor. This factor can be calculated by using the average number of people crossing the footpath during peak hour in same time for certain days in different locations.

2.4.4 Student factor (SF)

In case of school/college factor which increase or decrease the number of toilets will be the number of student in the survey school/college and the number of student and college in the place in which number of toilet is to be calculated. The number factor should be taken as of number of male and female respectively.

2.3.5 Bed factor (BF)

In case of hospitals the factor that should be chosen is according to bed which may vary from hospital to hospital. The factor which increase or decrease number of toilet will be the ratio of bed in which number of toilet is to be calculated and the number of bed from which data was collected.

2.3.6 Urinating and defecating time (UT& DT)

People urinate in about a minute but require some minute to defecate so to find number of toilet these time should be considered separately and number of urinals and defecator should be found out separately.

2.3.7 Urinating time factor (TF)

Time to urinate for female may take longer than that of male. So this factor always demand more number of toilet for female than male for equal proportion of female and male. This factor can be calculated by taking data of urinating time of certain number of male and female.

2.4 Hypothetical Function Using Controlling Factor

The hypothetical equation can be made for calculating number of urinals and defecating pan separately as the number of them varies with respect to variation of peak hour and time to finish each activities. The developed hypothetical equation according as public places as:

2.5.1 Bus terminal

- i. Urinates

$$F_{BT}(u,n) = PF * N_u * UT * DF * CF$$

- ii. Defecator

$$F_{BT}(d,n) = PF * N_d * DT * DF * CF$$

2.5.2 School/College

- i. Urinates

$$F_S(u,n) = PF * N_u * UT * SF$$

- ii. Defecator

$$F_S(d,n) = PF * N_d * DT * SF$$

2.5.3 Hospital

i. Urinates

$$F_H(u,n) = PF * N_u * UT * BF$$

ii. Defecator

$$F_H(d,n) = PF * N_d * DT * BF$$

Where

$F(u,n)$ - Function for number of urinals

$F(d,n)$ - Function for number of defecating Pans

PF - Peak factor for respective location

N_u - Average No. of Urinates in survey location

N_d - Average No. of Defecators in survey location

UT - Time for urinating

DT- Time for defecating

DF - Distance factor

CF - Crowd factor

SF - Student factor

BF -Bed factor

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 Study of Existing Situation

The study should focus on the existing situation of the public toilet so that the standard could be modified to the local condition which is favorable for the people of the locality. Also need of reviewing guidelines for the public toilet will be known from this study. The current scenario regarding the toilets in public places in case of Kathmandu city is very poor. For example Baneshwor is one of the place where public movement is high, but there is no any facility of public toilets. There is no sufficient toilets in the public places. Also the existing toilets are either sanitarily not maintained or not sufficient for the public. Somehow improvement is going on, by giving the permission to build the toilets to the private company for certain years.

In Koteshwor the public toilet in the name of City Service Centre was launched about a year ago, by Arati and Company Pvt. Ltd., in the land owned by the Department of Road which is in Right of Way of Araniko Highway. Facility like urinating, defecating, shower, saloon, café etc. are available here. This company will own this toilet for ten years and after the company will handover to Government or the agreement will be reviewed.

3.2 Identification of Public Places

The public places on which study must be conduct were identified. Public places like bus terminal, hospital, college were selected. As there is number of public places like theatre, malls, office buildings etc. also existed but bus terminals, hospitals are mostly linked with the public so this study is mainly focused on these places.

3.3 Data Collection and Analysis

The first task is to carry out survey from which some data regarding the time for urinating male and female separately and defecating can be found out from the numbers of people visiting the toilet. For this, one of the public toilet in Koteshwor is selected and the time for entry and exit is registered and then finally that time is selected in which most number of people performed to find out the urinating time for male and female and defecating time. This study was conducted in 29th Poush to 4th of

Magh. Also to find out peak hour for urinating and defecating was found out by counting number of people visiting toilet in different time. In terms of hospital the Civil Service Hospital was selected which provides 135 beds. Similar process as of bus terminal to find out the number of visitor during peak hour as that of male and female was carried. It was conducted during Falgun 14th to 20th. Also for educational institute Pulchowk college civil department was selected in which 420 student were studying. Similar process as of above to find out male and female visiting toilets in peak hour was followed. To find out the required number of water closet the peak hour data was used and the time for defecating was used but in the case of urinates the value of urinating time is in seconds and the most of the people for example in college visited the toilets in the break hour, out of which some minutes of that break was observed to be most critical number of visitors. So the number of urinates in that critical minute were useful to find the number of urinals.

For bus terminal factor like distance factor and crowd factor are also required. To find out distance factor questionnaires were developed and different distance and factor are presented so that participants can choose or suggest one of the factor from the option.

Also the data regarding time in which maximum number of people visit the public toilet is pointed out. And that time is point out as the peak hour in the case of public toilets.

3.4 Develop Questionnaires for Validation

First of all some hypothesis were developed to calculate the number of toilet in the public places and this hypothesis were presented in the people who were familiar to the field of sanitary so that this hypothesis can be used to generate the program. If the hypothesis made is not acceptable by the public or expert then the code generated will not be validated. With the help of public reaction one can easily find out the problem for them and can point out the necessary location for the construction of toilet. The kind of facilities public need and willingness of the people for the community based toilet can also be judged. Regarding the program hypothesis required to develop the code, questionnaires was prepared.

3.5 Software Development

This software was developed under Visual Basic environment using Microsoft Visual Studio. Microsoft visual studio is advance Microsoft windows software development tools. It contains C++, Vb.NET etc. code environment. For this study Visual basic environment was used. It is easy to develop and has interactive Graphical User Interface (GUI). computers. By collecting the data of the factors which determine the number of toilets in public places one can merge this data with logic in the program to determine the number of toilets in different type of public places. To develop a software firstly algorithm and flowchart was developed.

3.5.1 Algorithm

Algorithm is like a process which is to be followed to develop flowchart and program. Algorithm also helps other to know the logic how the program will be developed. The algorithm of the proposed program is listed as:

- i. Start
- ii. Enter urinating time for male (MUT) and female (FUT) in second.
- iii. Calculate urinating time factor ($TF = FUT/MUT$).
- iv. Enter defecation time (DT) in minutes.
- v. Choose location of toilet: Bus terminal; School/College; Hospital
- vi. If location is Bus terminal then
 - Select distance (D) of toilet location from terminal in meter
 - Enter Average no. of pedestrian (NOP) crossing footpath in that location.
 - Auto select distance factor (DF) from table provided.
 - Define average no. of pedestrian (SNOP) crossing footpath in survey location.
 - Calculate crowd factor ($CF = NOP/SNOP$).
 - Define average no. of male urinates (SMU) and female urinates (SFU) in surveyed location in peak hour.
 - Define average no. of male defecator (SMD) and female defecator (SFD) in surveyed location in peak hour.
 - Calculate required no of male urinals ($NMU = MUT * SMU * CF * SFD$).
 - Calculate required no of male Water closet ($WCM = DT * SMD * CF * DF$).
 - Calculate required no of female Water closet ($WCF = FUT * SFU * CF * DF + DT * SFD * CF * DF$).

vii. Else if location is School/College then

- Enter no. of male student (NMS) and Female student(NFS).
- Define no. of male student (SMS) and female student (SFS) in surveyed location.
- Calculate male student factor ($MSF=NMS/SMS$) and female student factor ($Fsf=NFS/SFS$).
- Define average no. of male urinates (SMU) and female urinates (SFU) in surveyed location in peak hour.
- Define average no. of male defecator (SMD) and female defecator (SFD) in surveyed location in peak hour.
- Calculate required no of male urinals ($NMU=MUT*SMU*MSF$).
- Calculate required no of male Water closet ($WCM=DT*SMD* MSF$).
- Calculate required no of female Water closet ($WCF=FUT*SFU* Fsf +DT*SMD*Fsf$)

viii. Else if location is School/College then

- Choose indoor or outdoor ward.
- Enter no. of bed of hospital (NOB).
- Enter no. of bed of hospital (SNOB) in surveyed hospital.
- Calculate bed factor ($BF=NOB/SNOB$).
- Define average no. of male urinates (SMU) and female urinates (SFU) in surveyed location in peak hour.
- Define average no. of male defecator (SMD) and female defecator (SFD) in surveyed location in peak hour.
- Calculate required no of male urinals ($NMU=MUT*SMU*NOB/SNOB$).
- Calculate required no of male Water closet ($WCM=DT*SMD* NOB/SNOB$).
- Calculate required no of female Water closet ($WCF=FUT*SFU* NOB/SNOB +DT*SMD* NOB/SNOB$).

ix. Do you want to calculate again.

x. If yes go to step v.

xi. Else End.

3.5.2 Flowchart

With the help of information obtained from algorithm one can develop criteria for public toilets. Then generating flowchart which will be helpful for developing program is another work. Finally with the flowchart and criteria, logical program will be developed. With the determination of different factor which controls the number of toilets in public places, the program can be develop which determines the requirement of number of public toilets. Flowchart is presented in Figure 3.8.

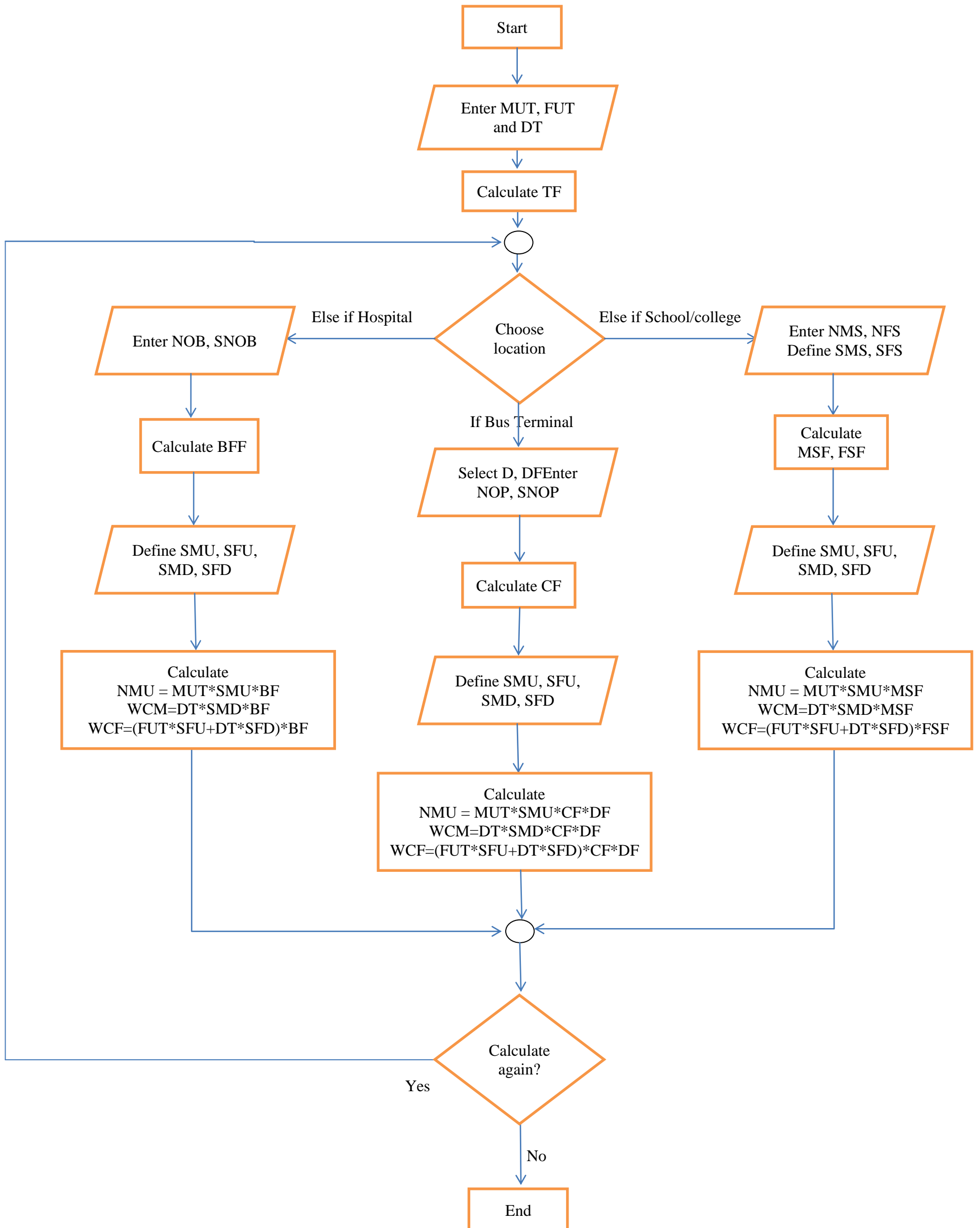


Figure 3.1 Flowchart for calculating no. of toilets

CHAPTER FOUR

4.0. RESULTS AND DISCUSSIONS

4.1 Urinating Time and Defecating Time

Number of observation regarding urinates according to gender was carried out. The male and female performer were observed with the stop watch with registration of enter and exit time. This survey was carried out in the city service center, one of the public toilet in Koteshwor in 29th of Poush and the data collected were presented in Appendix A. Urinating time for male and female are found to be different but the defecating time was found to be approximately same for male and female. The observed data is presented in Figure 4.1

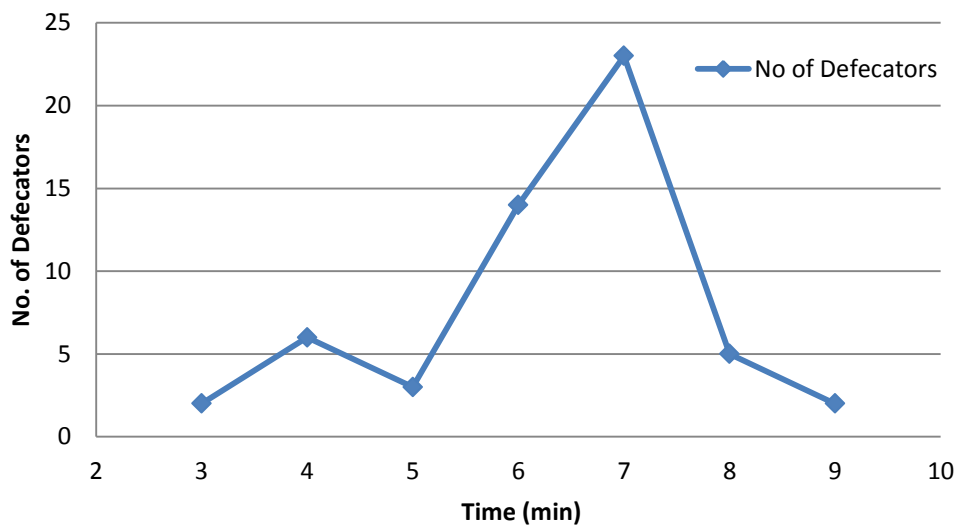


Figure 4.1 Time for defecating for male and female

From Figure 4.1, maximum number of people performed in 7 minutes, so Average time for defecating for people can be defined as 7 minutes for both male and female. Out of 55 people observed 37 people took time between 6 to 7 minutes. i.e. about 67% of people take about 7 minutes to defecate.

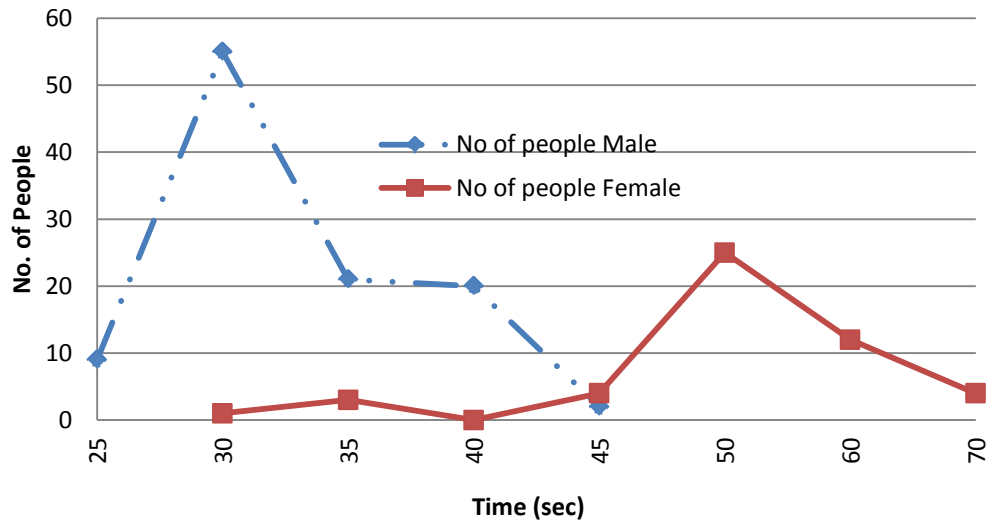


Figure 4.2 Time showing urinating time for male and female

from Figure 4.2 , average time for urinating for male is about 30 seconds in the public toilets. About 51% of people took 30 seconds time to urinate. Also from figure 4.2 , it is found that average time for urinating for female is about 50 to 60 seconds in the public toilets. About 75% of people were found in this range.

4.2 Peak Hour and Peak Factor

To find out the peak hour at the public places, data of the number of people visiting the public toilet were collected. Data for defecator were collected in hourly basis and the average of this data were calculated. Also from peak hour data and average data, peak factor was calculated. In case of average number of urinates the number of urinates in critical minutes at which number of visitor were maximum was used because to urinate short interval i.e about 30-50 second is required so if this is averaged for hour then the calculated number of urinals seems not so sufficient. If the hourly data is used to find the urinals number then it should be divided by sixty, so this data didn't help to find sufficient number of urinals so the number of visitors in some minute was used to estimate the number of urinals. And the average data for these critical minute is presented in Appendix A.

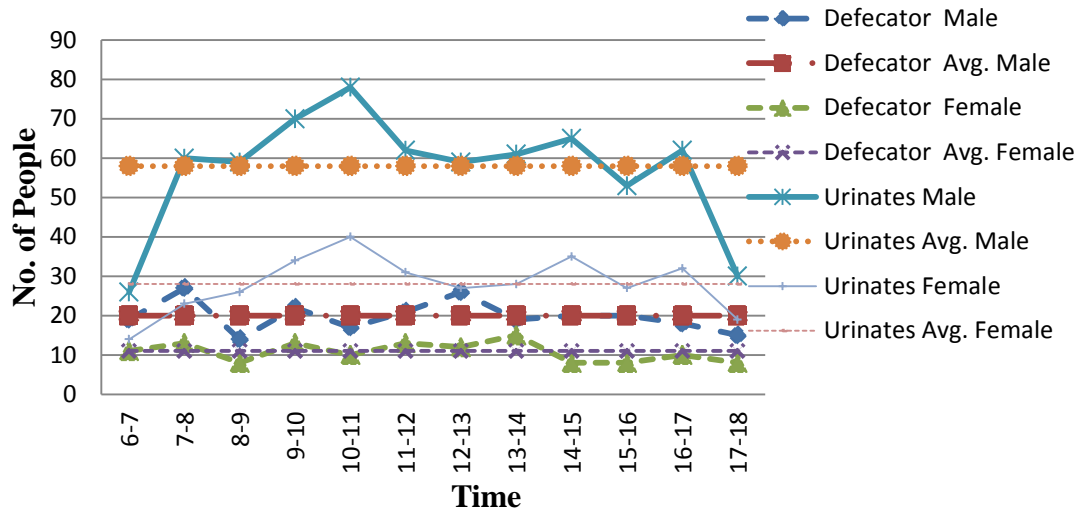


Figure 4.3 Peak hour for Urinates and defecator in bus terminal

From Figure 4.3 shows that in a bus terminals peak hour lies between 10 am to 11am for Urinates both male and female whereas for defecator it lies between 7 am to 8 am. Peak factor in bus terminal for urinates male is 1.34 and for female is 1.43 and in the case of defecator peak factor is 1.35 for male and 1.18 for female and these data are presented in Appendix A. Peak factor is the ratio of number of people in the peak hour to the average number of people, which would help to the project the maximum number of visitors from the hourly data.

4.2.2 Hospital

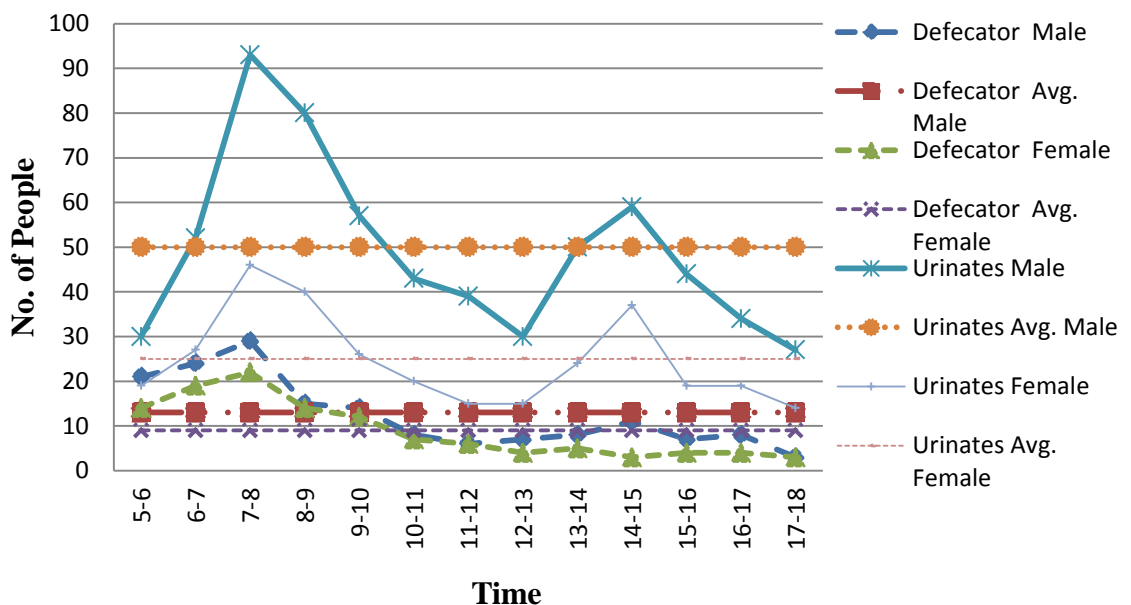


Figure 4.4 Peak hour for urinates and defecator in hospital

Figure 4.4 shows that in hospital peak hour lies between 7 am to 8 am for Urinates for both male and female and for defecator also it lies between 7 am to 8 am. This data was collected from the Civil hospital outdoor ward which is of 135 beds. This time occur as a peak hour because in the morning token were distributed for appointment. Peak factor in hospital for urinates male is 1.86 and for female is 1.84 and in the case of defecator peak factor is 2.23 for male and 2.44 for female.

4.2.3 School/College

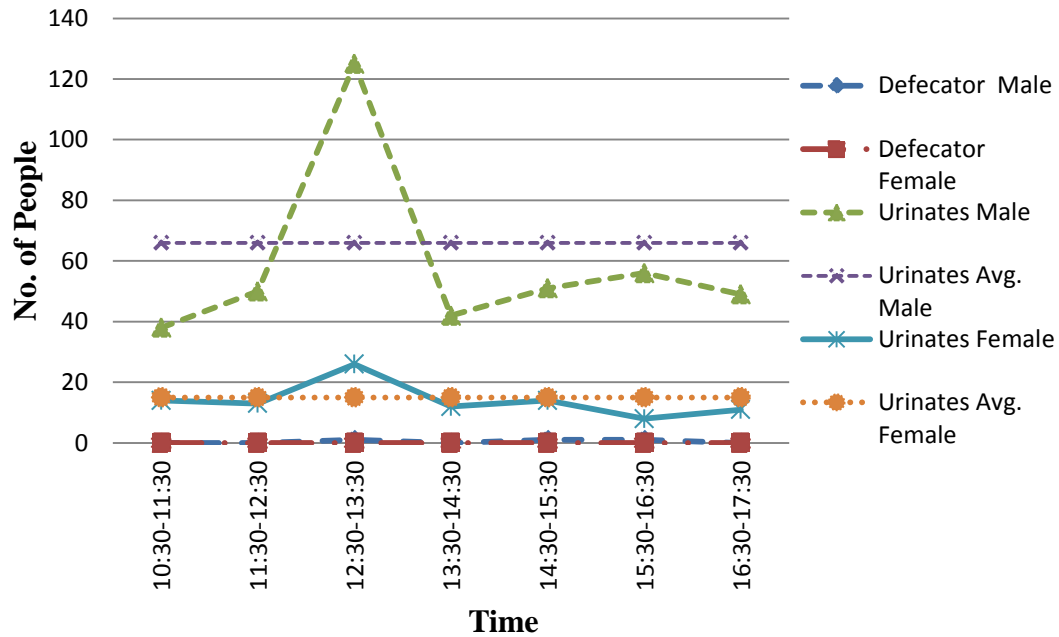


Figure 4.5 Peak hour for Urinates and defecator in college

Figure 4.5 shows that in a college peak hour lies between 12:30 pm to 13:30 pm for Urinates both male and female. This time is break hour of the college so the maximum performer were observed. This data was collected from the pulchowk campus civil department. In this department there are 480 student out of which 411 are male and 69 student are female. Peak factor in college for urinates male is 1.89 and for female is 1.73 and in the case of defecator there is no significant visitor for this purpose in the toilets in the college so this number is calculate with the help of Nepal Building Code standard.

4.3 Distance Factor and Crowd Factor

Distance factor is dependent upon the distance of toilet from the bus terminal. This factor contribution according to distance was found out from the questionnaires survey. Distance and the respective factor is presented in Table 4.1.

Table 4.1 Distance and Distance factor

Distance(m)	50	100	150	200	250	300
Distance factor(D.F)	1	0.95	0.9	0.8	0.75	0.7

Crowd factor is another factor which shows the how crowd is one place with respect to other. In this study the factor is found out by counting the people crossing the footpath in the peak hour time of the bus terminal public toilet data. The surveyed place was Koteshwor where average people crossing the footpath was 400. Also the number of people crossing the footpath in the Baneshwor at the same time was counted which was found to be 600 number in average. So the factor is 1.5 for Baneshwor with respect to Koteshwor.

4.4 Estimation of Number of Toilets using Software

The developed software require the input data like urinating time for male and female, and defecating time which is already found out in this study but one can change if he/she want to change the data. Next option is to choose the public location between bus terminal, school/college and hospital. Various types of data according as type of public location should be provided in the next step. Then the output will give the required number of urinals and water closet for male and total number of water closets for female. For example from the developed software required number of urinals for male in Pulchowk campus civil department is 28 male and the existing number of urinals are 31 which shows enough urinals are available for male. In case of female there are only two water closets but required number is 8 calculated from this software so suggestion to add the water closets for female can be provided. The frame of the software application look like as:

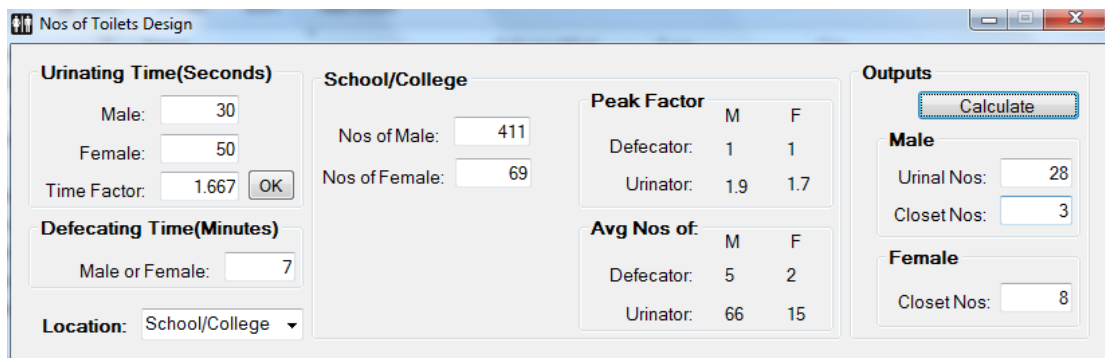


Figure 4.6 Outlook of the application

CHAPTER FIVE

5.0. CONCLUSION AND RECOMMENDATIONS

5.1 Conclusions

The main purpose of the study is to determine the required number of toilets in the public places like bus terminals, school/college, hospitals etc. Also the time for urinating for male and female was considered to find out the respective urinals and water closets number. The study can be concluded as:

- In this study time for urinating male was found to be 30 seconds and for female was 50 seconds whereas defecating time for male and female was 7 minute.
- Different peak factor according as location was found. For bus terminal in case of defecator male peak factor was 1.35 and for female was 1.18 in terms of urinates 1.34 was for male and 1.43 was for female. For hospital in terms of defecator male peak factor was 2.23 and for female is 2.24 and in terms of urinates 1.86 was for male and 1.84 was for female.
- With the help of program developed number of toilet required for the survey location Koteshwor public toilets were 6 urinals for male and existing were 5, 4 water closets for male and existing were 5, and 6 water closets for female whereas existing werw 6 in this case. And for Pulchowk college, F- Block required number of urinals were 28 and existing were 31, which is enough numbers, required number of water closets form the program and existing both were 3 and in case of female water closets required number from program were 8 but the existing number of toilets were only 2.
- Determination of number of public toilets in bus terminal, hospital, school/college was carried out.
- Factors such as peak factor in peak hour, crowd factor and distance factor for bus terminal is known.
- Time for urinating for male and female was found separately and defecating time was also found for both male and female.

5.2 Recommendations

The recommendations made for further study are as:

- Other public places like shopping malls, theatre, office building can also be studied.
- Toilets requirement for disable people can also be studied.

References

1. National Building Code (NBC 208:2003), Department of Urban Development and Building Construction, *Sanitary and Plumbing Requirement, Government of Nepal*, pp. 19-25
2. Clara Greed, (2003), *A code of practice for public toilets in Britain*, pp. 3 - 8
3. Canterbury City Council (2008), *Provision of toilets in commercial premises open to the toilet*, <http://www.canterbury.gov.uk/>, pp. 2-4
4. Ananta Ram Baidya ,(2015) <http://www.myrepublica.com/portal/index.php>

APPENDICES

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B	Questionnaires	45-47
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Peak Hour Data

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1. Bus Terminal Data	38
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3. College Data `	42

Peak Hour Data (Bus terminal, 30th Poush)

Time	No. of People			
Duration	Defecator		Urinator	
	Male	Female	Male	Female
6-7	17	9	22	11
7-8	25	11	61	21
8-9	13	7	57	24
9-10	23	12	71	33
10-11	14	8	81	41
11-12	19	13	61	32
12-13	24	12	53	25
13-14	21	15	59	25
14-15	22	9	67	37
15-16	19	7	51	23
16-17	16	9	59	29
17-18	13	8	31	16

Peak Hour Data (Bus terminal, 1st Magh)

Time	No. of People			
Duration	Defecator		Urinator	
	Male	Female	Male	Female
6-7	20	12	29	16
7-8	29	15	58	24
8-9	15	9	60	27
9-10	21	14	69	35
10-11	19	11	75	38
11-12	22	12	63	30
12-13	27	11	64	29
13-14	16	14	62	30
14-15	18	7	63	32
15-16	21	9	55	30
16-17	19	11	65	35
17-18	16	8	28	21

Avg. data in bus terminal

Time	No. of People							
Duration	Defecator				Urinate			
	Male	Avg. Male	Female	Avg. Female	Male	Avg. Male	Female	Avg. Female
6-7	19	20	11	11	26	58	14	28
7-8	27	20	13	11	60	58	23	28
8-9	14	20	8	11	59	58	26	28
9-10	22	20	13	11	70	58	34	28
10-11	17	20	10	11	78	58	40	28
11-12	21	20	13	11	62	58	31	28
12-13	26	20	12	11	59	58	27	28
13-14	19	20	15	11	61	58	28	28
14-15	20	20	8	11	65	58	35	28
15-16	20	20	8	11	53	58	27	28
16-17	18	20	10	11	62	58	32	28
17-18	15	20	8	11	30	58	19	28
Average	20	20	11		58		28	
Peak Factor	1.35		1.18		1.34		1.43	

Bus terminal data

Date	No. of Urinate		Urinate in critical minute	
	Male	Female	Male	Female
poush 29	68	34	14	5
poush 30	75	38	11	6
Magh 1	79	46	10	4
Magh 2	78	31	13	3
Magh 3	66	37	12	2
Magh 4	83	42	11	2
Average of 1 week	75	38	12	4

Hospital Peak Hour Data

Falgun 14th

Time	No. of People			
Duration	Defecator		Urinatees	
	Male	Female	Male	Female
5-6	19	12	32	21
6-7	23	17	49	25
7-8	31	24	99	43
8-9	16	15	78	37
9-10	10	12	51	29
10-11	7	5	42	18
11-12	4	7	33	13
12-13	8	3	24	15
13-14	11	3	47	22
14-15	13	2	63	34
15-16	6	4	54	21
16-17	8	5	41	16
17-18	3	3	34	13

Hospital Peak Hour Data

Falgun 15th

Time	No. of People			
Duration	Defecator		Urinatees	
	Male	Female	Male	Female
5-6	22	16	27	16
6-7	25	21	54	28
7-8	27	19	87	49
8-9	14	13	81	43
9-10	17	12	62	23
10-11	8	8	43	21
11-12	7	5	44	17
12-13	5	4	36	14
13-14	4	7	53	26
14-15	9	3	55	39
15-16	7	4	33	17
16-17	8	2	26	22
17-18	2	3	19	14

Average data in hospital

Duration	Avg. Defecator		Avg. Urinates	
	Male	Female	Male	Female
5-6	21	14	30	19
6-7	24	19	52	27
7-8	29	22	93	46
8-9	15	14	80	40
9-10	14	12	57	26
10-11	8	7	43	20
11-12	6	6	39	15
12-13	7	4	30	15
13-14	8	5	50	24
14-15	11	3	59	37
15-16	7	4	44	19
16-17	8	4	34	19
17-18	3	3	27	14
Average	13	9	50	25
Peak Factor	2.23	2.44	1.86	1.84

Date	No. of Defecator	
	Male	Female
Falgun 14th	31	24
Falgun 15th	27	19
Falgun 16th	25	27
Falgun 17th	34	21
Falgun 18th	22	17
Falgun 19th	29	20
Falgun 20th	26	18
Average of 1 week	28	21

Date	No. of Urinates		Urinates in critical minute	
	Male	Female	Male	Female
Falgun 14 th	99	43	12	7
Falgun 15 th	87	49	11	5
Falgun 16 th	76	58	16	4
Falgun 17 th	108	37	13	7
Falgun 18 th	91	42	10	6
Falgun 19 th	83	48	15	5
Falgun 20 th	94	56	16	8
Average of 1 week	92	48	14	6

College Peak Hour Data

Falgun 5

Time	No. of People			
Duration	Defecator		Urinates	
	Male	Female	Male	Female
10:30-11:30	0	0	34	11
11:30-12:30	0	0	51	12
12:30-13:30	2	0	131	28
13:30-14:30	0	0	39	8
14:30-15:30	0	0	48	15
15:30-16:30	1	0	64	11
16:30-17:30	0	0	46	14

Falgun 6

Time	No. of People			
Duration	Defecator		Urinates	
	Male	Female	Male	Female
10:30-11:30	0	0	41	16
11:30-12:30	0	0	49	13
12:30-13:30	0	0	119	24
13:30-14:30	0	0	44	15
14:30-15:30	1	0	53	12
15:30-16:30	0	0	47	5
16:30-17:30	0	0	51	7

Average Data in college

Duration	Avg. Defecator		Avg. Urinates	
	Male	Female	Male	Female
10:30-11:30	0	0	38	14
11:30-12:30	0	0	50	13
12:30-13:30	1	0	125	26
13:30-14:30	0	0	42	12
14:30-15:30	1	0	51	14
15:30-16:30	1	0	56	8
16:30-17:30	0	0	49	11
Average			66	15
Peak Factor			1.89	1.73

Number of Urinates in College

Date	No. of Urinates		Urinates in critical minute	
	Male	Female	Male	Female
Falgun 5th	131	24	53	7
Falgun 6th	119	28	61	7
Falgun 7th	142	31	49	6
Falgun 9th	123	26	59	10
Falgun 10th	134	30	57	7
Falgun 11th	116	21	54	9
Average of 1 week	128	27	56	8

QUESTIONNAIRES

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8. What should be the average acceptable time limit for urinating for male?
A. 30 sec B. 40 sec C. 50 sec D.
9. What should be the average acceptable time limit for defecating?
A. 5 min B. 6 min C. 7 min D.
10. Is it reliable to calculate the no. of toilet according to time of defecating/urinating separately?
A. Yes B. No C.
11. What ratio of Urinates with respect to defecator should be considered?
A. 1.5:1 B. 2:1 C. 3:1 D.

Any comment and other possible questions will be highly appreciated.

Q2. QUESTIONAARIES TO FIND DISTANCE FACTOR

Name:

Roll No.

12. What distance public will walk without hesitation up to public toilets in public terminals?

B. 20 B. 30 C. 50 D.....

13. By what factor number of public will be decrease if the public toilet is in 100M?

C. 0.95 B. 0.90 C. 0.85 D.....

14. By what factor number of public will be decrease if the public toilet is in 150M?

A. 0.90 B. 0.85 C. 0.80 D.....

15. By what factor number of public will be decrease if the public toilet is in 200M?

A. 0.85 B. 0.80 C. 0.75 D.....

16. By what factor number of public will be decrease if the public toilet is in 250M?

A. 0.80 B. 0.75 C. 0.70 D.....

17. By what factor number of public will be decrease if the public toilet is in 300M?

A. 0.75 B. 0.70 C. 0.65 D.....

18. What distance public willnot walk upto public toilets in Bus terminals?

A. 300 B. 350 C. 400 D.....

PHOTOGRAPHS

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P1: Worker cleaning toilet space in Koteswor



P2: Existing urinals at Pulchowk Campus



P3: Snap during data collection



P4: Crowd at Civil Hospital