ENABLING ENVIRONMENTS FOR THE MOBILITY IMPAIRED IN THE RURAL AREAS

A THESIS

Submitted in partial fulfilment of the requirements for the award of the degree of

DOCTOR OF PHILOSOPHY

by

GAURAV RAHEJA

CENTRAL LIBRARY
ACC No G14265
Date 29/7/09
I.I.T. ROORKEE

DEPARTMENT OF ARCHITECTURE AND PLANNING
INDIAN INSTITUTE OF TECHNOLOGY ROORKEE
ROORKEE - 247 667 (INDIA)

JULY, 2008

©INDIAN INSTITUTE OF TECHNOLOGY ROORKEE, ROORKEE, 2008
ALL RIGHTS RESERVED

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE
ROORKEE

CANDIDATE'S DECLARATION

I hereby certify that the work which is being presented in the thesis entitled **ENABLING ENVIRONMENTS FOR THE MOBILITY IMPAIRED IN THE RURAL AREAS**, in the partial fulfilment of the requirements for the award of the Degree of Doctor of Philosophy and submitted in the Department of Architecture & Planning, Indian Institute of Technology Roorkee, is an authentic record of my own work carried out during a period from July 2002 to July 2008 under the supervision of Prof. S Y Kulkarni, Professor, Department of Architecture & Planning and Dr.S C Handa, Professor (Retd.), Quality Improvement Programme Centre, IIT Roorkee.

The matter presented in the thesis has not been submitted by me for the award of any degree of this or any other Institute.

Gaurav Raheja

(GAURAV RAHEJA)

This is to certify that the above statement made by the candidate is correct to the best of our knowledge.

S. C. Handa

(S C Handa)
Supervisor

(S Y Kulkarni)
Supervisor

Date: July 30, 2008

The Ph.D. Viva-Voce Examination of Mr. **Gaurav Raheja**, Research Scholar, has been held on .....

Signature of Supervisors

Signature of External Examiner

ACKNOWLEDGEMENTS

On this path opening avenues for research, the journey made me see, observe, read, listen, think and it still leaves me on a thoughtful note about, "How to express my profound gratitude towards all those who had directly or indirectly been of some influence to this PhD thesis in its present form?" I find it difficult to measure, quantify and express as in how much could I learn in these years. It remains a fact, that it was a period of personal gain which would not have seen the light of this day till I gratefully acknowledge those who in their humane, divine and loving forms contributed to my learning.

My disciplehood under the mentorship and supervision of Prof. S Y Kulkarni and Prof. S C Handa has flourished on this research platform wherein meaningful discussions, invoking thoughts, intriguing questions, a genuine concern and a gentle touch of a guru has led me this far. Prof. Kulkarni's actions of humility, probing ideas conveyed through sheer simplicity have been a great source of inspiration for me all through. During the course of my thesis, I found in him a philosopher friend, a humane personality coupled with a strong support of a guru. Prof. Handa's drive to serve in the disability sector has somewhere been a constant source of motivation to my soul. His persistent efforts, able guidance, tremendous experience and quality work spirit became the source of learning during his mentoring in my thesis work. I am deeply indebted to my guides for having shown me the way.

This PhD thesis in its inception required insights from diverse fields of interaction especially its intent dealing with enablement of people with impaired mobilities through environmental design interventions. Discussions with Dr S C Mehta, Dr S K Goel, Dr G G Ray, Prof. Ravi Hazra, Dr. M Parida and Dr. Sunil Katoch provided meaningful insights into my work. Not to forget, Madam Kusum Chopra, whose guidance and an encouraging support with lots of affection, helped me wade through this phase with confidence. With deep respect, I acknowledge the great support I found in learning from their valuable experiences.

I am grateful to the Department of Architecture & Planning, Indian Institute of Technology Roorkee for giving me the opportunity for pursuing Doctor of Philosophy programme and to the Ministry of Human Resource Development, Government of India for providing the financial assistantship for my research studies.

I would never forget the time spent with my friends at the Department of Architecture & Planning and Azad Bhawan, where I had fruitful discussions on various aspects with them and their time to time advice that has influenced my personal development during my stay at Roorkee. Santosh, Hemant, Varun, Arif, JayPrakash, Samarjeet, Balwinder, Nilesh, Vivekanand, Sudhanshu, Vikas, Rajinder and Purnima maa'm all contributed in different ways to my cherishing memories and beautiful experiences during this phase of work. My salutations to all of them for having been

there. My rescue team comprising of Ashwani, Sunil ji, Ajay ji, Deepa ji, Bibhu, Ankur, Puneet, Krishna & Himanshu deserves a special thanks for having stood by me when I needed their support the most.

Words would tremble to thank the survey participants and their families who amidst their weak economic conditions contributed whole heartedly by their times, efforts of simulating Activities of Daily Living and intriguing inputs for discussions. Words seem futile to thank those people with beautiful hearts who offered a cup of tea in their sweet little homes. It was worth gathering inputs and learning from them. I gratefully acknowledge the relentless support rendered by Dinesh in the form of personal assistance during the survey trips.

The divine process of bringing during this phase into my life another soul has been a timely intervention. My wife, Divya deserves a special mention and a heartfelt thanks for having stood by me through the final phases of my work with a strong moral and loving support. I extend my love and thanks to my wife Divya for her patience, extensive cooperation and constant encouragement for the completion of my work. Blessings from my parents in laws as a warm support heightens a sense of gratitude in my heart.

Not to forget the coming of my little niece, Gauri into this world during this journey, in whose name a number of pleasant times were spent with my brother and bhabi. The umbrella of selfless love, rich care and a tender support through my Parents, has been an unforgettable and a very touching experience of my life. Had it not been their dedication, that inspired me to undertake this path, this work would have been only a dream to me. Their sweet blessings coupled with immense support, pristine love and those silent communications of encouragement held me strong till the end to compile my work in its present form. I find myself to be speechless yet full to express my gratitude towards this divine incarnation of my worthy parents.

Wanderings in the quest of knowledge and seeking to learn more were the chosen objectives to walk in the direction of research. By now, all that I could realize is the need for greater advancements in wisdom to make a breakthrough in understanding complex issues with sheer simplicity. In the midst of realities of poverty, compounded with challenges of limited mobility, as seen during the course of my survey, was something that transfers my thinking process from a physical to a metaphysical plane. However, a constant inner faith as a guiding light provides a tranquil source of motivation to pursue research for a human cause. In the breath of those ideas, in the thoughts of that ideal, I continue my journey forward by dedicating this work to the one's whom I studied and knew about through this research. No words can express the inner contentment that one derives at the end of it. My sincere thanks to my all time friend, the Almighty Lord, who blessed me by giving me a chance.

(Gaurav Raheja)

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

List of Acronyms

ALIMCO	Artificial Limbs Manufacturing Corporation
AD	Assistive Devices
ADL	Activities of Daily Living
AT	Assistive Technology
BPL	Below Poverty Line
CBR	Community Based Rehabilitation
CRP	Centre for the Rehabilitation of the Paralysed
CRWS	Community rehabilitation workers
CBRI	Central Building Research Institute
CSIR	Centre for Scientific & Industrial Research
DFID	Department for International Development
EFIM	Environmental Functional Independence Measure
FIM	Functional Independence Measure
FPM	Functional Performance Measure
IADL	Instrumental Activities of Daily Living
IBR	Institution Based Rehabilitation
ILO	International Labour Organisation
ICF	International Council of Functioning
ICIDH	International Classification of Impairments, Disabilities and Handicaps
NGO	Non-Government Organisation
PGI	Post Graduate Institute (of Medical Science at Chandigarh)
PWD	People with Disabilities
PER	Perceptual Experience Rating
PCC	Plain Cement Concrete
PHE	Public Health engineering Department
P - E	Person - Environment
RES	Rural Engineering Services
UNDP	United Nations Development Programme
UN	United Nations
URS	Usability Rating Scale
WHO	World Health Organisation

Chapter 1

INTRODUCTION

Almost anything you do will be insignificant but it is very important that you do it.

-Mahatma Gandhi

1.1 INTRODUCTION

Impaired mobility, low economic status and lack of infrastructural facilities in the environment, present multifold challenges for persons with locomotor disabilities to exist, live and perform their routine of daily activities in the rural settings of a developing country. Local adaptations amidst poverty coupled with poor rehabilitation services, call for a greater insight into understanding the living patterns of these people. It becomes imperative to address these issues with a broad, holistic and a sustainable approach towards the concept of integrated living.

While the world of haves is witnessing advancements in research and technology, the world of have-nots looks onward in a hope to receive some benefits percolating from the developments around. Some of us have an ability to adapt more readily than others. Mobility is critical to the human fabric (Mulholland, et al, 1996). It is essential for almost all works of daily life including self care, sanitation activities, work and play. Without mobility, the barriers to participation are immense (Packer, T., 1994). Theory of enabling environments is making its impact in the developed nations through a growing body of disability rights legislation. The growing knowledge through research in this area (from the developed nations like United States, Canada and Europe) is also finding its application in the developing countries, though largely in the urban contexts.

Rural populations (able bodied and persons with disabilities) form the major component of human resources in the developing nations that exist with minimal support structures. It is time to advance the understanding of the issues of mobility impaired in those low income communities of the rural environments so as to contribute towards enabling them in their own environs.

1.2 BACKGROUND CONTEXT

India is the seventh largest country in terms of area and is a melting pot of diverse living characters ranging from social, cultural and economic conditions to geographic, climatic and political domains. Unlike the developed nations of the western world, the urban (30%) and rural (70%) populations complete the Indian demographic scene of over 100 million population. The urban scene is however, making pace with the rest of the world, while the rural scene still remains neglected in its basic amenities and other infrastructural support.

This leads to exclusion of a quantum of human resource i.e. the persons with disabilities from participation in their activities of daily living and mainstreaming. The exclusion of disabled people has an impact on their families and communities, in both human and economic terms. (Jones, H. et al, 2002). Poverty reduction programmes, universal primary education drives, and economic growth targets all need to include disabled people if they are to meet their objectives (Stubbs, 2002).

Jones, H. *et al* (2001) reported that one in five of the world's poorest are disabled, for whom access to basic rights is a daily struggle. Exclusion from basic services and facilities, such as sanitation and safe water, can result in reduced opportunities, isolation, poor health and poverty. She highlighted that the economic costs of excluding disabled and frail elderly people far outweigh the costs of including them. An estimate of GDP lost as a result of disability is between $1.3 and $1.9 trillion (Metts,2000). The desirable standard

of living cannot be achieved unless an inclusive approach is implemented at the grass root level.

While identifying the design problems of India, Nadkarni, S. (1977) concluded in his paper ' India lives in her villages and if ypu want to improve her lot, you have to work with the people here and not merely for the people there.' He further stated, that the designer should work as a member of the village community, and not serve as a feeder to the community.

India, in its personal interest of care for its citizens and being a signatory to the UNCRPD stands at the thresholds of its contribution to the millennium development goals of poverty reduction, health and access to safe water and sanitation. Without accessing the needs of the disabled, it would howeever be difficult to equitably achieve the above stated millennium goals. Yet they continue to be largely ignored by mainstream infrastructure and development programmes.

With the above discussed background, this research broadly aims at getting closer to the realities of the mobility impaired in the rural context in order to contribute towards enablement through making suggestions in the form of theoretical model, designs and recommendations.

1.3 DISABILITY AND ITS LEGISLATIVE CONTEXT

Disability, as a term may be singular but its regional constructs have led its interpretation in their own possible ways. However, there exists a global consensus on the fact that an individual's disability should not extend to render him handicapped, for handicap is considered to be an environmental prerogative than being only an individual's limitation. A nation's political environment and legislative framework have been instrumental in accelerating or decelerating the support rendered to the have-nots. Disability Rights Movement across the world have today got a major paradigm shift from a charity based

living to a rights based society which has led to the concept of Independent Living. American Disabilities Act has been a leading reference in that direction.

India, as a developing nation also became a signatory to the UN convention which led to the passing of the Indian Disability Act in 1995 which in its Section VIII (45) states that there shall be no discrimination in the built environment on the basis of disability. Legislations are precursors towards providing a change in the environment both physical and social that the disabled can effectively function in. Implementation and monitoring are essential for actual benefits to accrue to the target population.

According to the Indian Disability Act, "disability" means, (i)Blindness; (ii)low vision; (iii)leprosy-cured; (iv) hearing impairment; (v) locomotor disability; (vi)mental retardation; (vii)mental illness, while locomotor disability means disability of bones, joints or muscles leading to substantial restriction of the movement of the limbs or any form of cerebral palsy. The Act also states that for a disability to be considered valid for legislative response, it needs to be certified by a medical authority for the degree of disability to be greater than 40%.

The above definitions in its inception stage have facilitated action on the ground at the national scene, however it is still limited to the metropolitan cities and large urban areas. Also, with the development of state of the art concepts on disablement process through International Council of Functioning(ICF), World Health Organisation (WHO), the definitions provided in the Indian disability act, excludes diverse groups of people with functional limitations otherwise not covered through the definitions. As a result, they are excluded from any form of legislative support.

1.4 DEMOGRAPHIC STATUS

UNICEF (1980) estimates that about one in ten of the world's population are born with or acquire some sort of disability. Therefore, there may be more than 500 million people with special needs (WHO, 1999). Other studies suggest that the prevalence of disability may be between 15 and 20% of the population of developing countries (Renker, 1982; World Bank, 1999). However, the number is increasing annually through population growth. Eighty percent of all disabled people live in developing countries and one third are children (Thornburn & Marfo, 1990; WHO, 1999). Developing countries only account for 10% of the global health expenditure, but have to deal with 90% of the global burden of disease (Murray & Lopez, 1997). The author suggests that the number of disabled people in the developing world is around 400 million people. All disability statistics need careful interpretation as the term 'disability' is culturally and contextually dependent (Miles, 1999).

The Indian disability census (2001) reports a total of approximately 6 million people with movement disabilities which accounts for 27.87% (Table 1.1) of the total percentage of disabled people.

Table 1.1 Disability Statistics (Census of India, 2001)

Types of Disabilities	Number of Disabled	Percentage
Seeing	10634881	48.55
Speech	1640868	7.49
Hearing	1261722	5.76
Movement	**6105477**	**27.87**
Mental	2263821	10.33
Total	21906769	100.00

It is further reported in the census that out of all persons with movement disabilities, 76.24% live in the rural areas while only 23.76% live in the urban areas. Sen (2006) mentions in her paper these census figures may indicate serious level of undercounting.

Balaram (2001) reported that India already has one – third of the world's disabled population. He further adds, 'While an accurate census is difficult due to huge and illiterate village populations, an approximate 63 million people in India suffer from impairment in physical or mental form. Sharma, N (2006) stated that there are 9 million people with locomotor disabilities in India of whom 4 million require mobility devices.

1.5 NEED FOR THE STUDY

Research in the context of enabling environments has mostly been from the perspective of developed nations catering to the urban contexts. However, researches to understand interrelationships between disability and environmental factors have led to the development of theory in this area. Indian context represents the developing nation's scenario wherein studies in the context of environment-disability relationships are in a nascent stage with a focus on urban city centres. Findings from literature and discussions with experts confirmed that not much work has been done in the perspective of enablement through design for persons with disabilities in the rural context. Issues enlisted below, catalyze the need for research in this area:

1. **Demographic Issues** – Indian disability demographics reflects a high incidence rate of movement disabilities, especially in the rural areas (76%).
2. **Need for Inclusion -** Need to integrate the people with mobility impairments and other disabilities to mainstream participation, since the costs of exclusion are very high.
3. **Lack of Relevant Information** – There is a lack of relevant information about the individual needs and rehabilitation preferences of the mobility impaired in rural settings.

4. **Lack of Reliable Methodological Frameworks** – To collect data of persons with disabilities in the rural environments of developing nations and conduct research is still considered a mammoth task in the absence of reliable methodological frameworks. However, standardized lab based environments for researching on accessibility issues have been developed in the advanced nations of the world which is difficult to replicate for rural environments. It thus calls for an effort to study the performance of Activities of daily living by persons with mobility impairments in their naturalistic conditions.
5. **Basic Human needs and rights** – Provisions for non discrimination of persons with disabilities in the built environment by the Indian Disability Act provides enough reasons for the need to extend this as a policy directive into practice.
6. **Access promotion in the rural areas** – Lack of access in the rural environments is a resultant of complex interactions between physical, social and institutional barriers prevalent around us. While urban environments are still witnessing progress in access promotion, appropriate measures are required to promote access in rural environments.
7. **Advancing the Theory of Enabling Environments** - Lack of a good theoretical foundation on enabling environments in the rural areas.

1.6 RESEARCH OBJECTIVES

The new world is fast treading to an inclusive approach to design and living, thus supporting independent living paradigms. Such approaches across the world are evolving and being implemented and reviewed. The beginning in India has already been made during 1995 through the passing of the Persons with Disabilities Act, which further needs to be complemented with a strong action approach in the rural environments. Access provisions in the rural context for persons with limited mobility require an understanding of various personal and environmental factors in play before making direct implementations. Hence to achieve the higher aims, a set of following objectives has been framed for the present investigation.

1. To study the **socio economic** and **socio cultural** characteristics of the people with mobility impairments in the rural environments.

2. To **assess the rehabilitation preferences** of the subjects with mobility impairments in the study area.

3. To **identify the barriers and facilitators** in the performance of Activities of Daily Living within and outside their home environments.

4. To **document the process of activity performance** focusing on activities of self care in their natural environmental settings.

5. To develop **conceptual design solutions** for adaptations or alternative approaches for improving performance of Activities of Daily Living through access.

6. To develop a survey based **methodological framework** for further investigation and research studies for data collection, analysis and solutions in low income communities of rural environments.

7. To suggest a **theoretical model** of understanding and implementation for the integration of people with mobility impairments in the mainstream activities.

8. To **recommend design guidelines** for the creation of enabling environments as a holistic approach for developing accessible rural environments.

1.7 PHILOSOPHY OF THE WORK

The underlying philosophy of this research investigation is that conscious removal of environmental barriers can facilitate some degree of mobility to the ones who have lower limb impairments / locomotor disabilities. While lack of proper infrastructure and low incomes characterize the mobility impaired in the rural areas, environmental barriers play a major role in denying access to basic activities of daily living.

Though it may be a high ambition to discover a single solution to the problem, this research advocates a definite approach through a strategic model to understand the issue at a macro level and suggests micro level parameters / environmental variables as the agents of change. This would be an exploratory descriptive thesis on a survey and case study based approach. The philosophy of this thesis advocates

1. A shift in approach from medical to a social model based thinking for persons with disabilities (mobility impairments) in the rural environments.

2. From a Government based rehabilitation to an integrated model of rehabilitation which is self sustainable at the village level. This could be done by cross disciplinary exchange at the understanding and policy level planning. It may span from the fields of disability as a medical understanding to design interventions through assistive technology and environmental changes further extending to removal of barriers and social/attitudinal changes through information based awareness.

3. To improve knowledge through sharing and documentation of the existing practices and problems faced by mobility impaired persons in low income communities of Indian rural environments.

1. 8 ORGANISATION OF THE THESIS

The study consists of six chapters devoted to various aspects of issues addressing the context of enablement for persons with mobility impairments in the rural areas. A brief description of the salient features deliberated is highlighted in the following paragraphs.

The first chapter introduces the subject and gives an overview. It deals with the need for study and the objectives framed under its framework. Besides these, it spells out the methodology that has been adopted.

The second chapter covers the review of relevant literature on the subject. Most of the literature is derived from the western context to understand the development of various paradigms over past three decades. However, special attention has been paid to gather information and identify literature from other developing nations so that an orientation towards Indian context could be derived from it.

Chapter three deals with the research design highlighting the study area context, sampling strategies, inclusion – exclusion criteria and the tools adopted for data collection and analysis. It concludes with the limitations of the methodology.

In Chapter four, the results obtained from the survey have been presented and discussed. It mainly deals with socio demographic and socio cultural parameters in addition to assessing the disability status of the persons with mobility impairments chosen as subjects for this study. Rehabilitation preferences of the respondents are also presented in this chapter.

Chapter five focuses on the qualitative analysis of the performance of activities of daily living by the subjects as observed through the survey. It identified the barriers and facilitators as experienced by the survey respondents and discusses the issues pertaining to ADL performances in their context. Towards the end, it proposes design recommendations with conceptual designs in addition to proposing a theoretical model for implementation.

Chapter six synthesizes the major conclusions derived from this research investigation and issues recommendations based on comprehension of the findings. It also suggests scope for further research in this area that have evolved from this work.

Chapter 2

REVIEW OF LITERATURE

2.1 INTRODUCTION

Research studies on enabling environments have been focused from diverse perspectives involving a multi disciplinary exchange of knowledge spanning from architecture, psychology, occupational therapy, human factors to sociology of disability rights. From the early, 1970's as the beginning of research in this direction till date, a substantial amount of research efforts have been made in developed nations like United States, Canada, United Kingdom, Sweden, Netherlands etc. to advance and develop theory on the issues of enablement.

From disability rights legislation to deinstitutionalization, from barrier removal strategies through environmental design interventions to rehabilitation research, efforts are growing world over with a focus on integration of persons with disabilities to mainstream with a realization to improve their overall quality of life. Current and past research practices have found enough evidence to understand disablement process as not just a cause of individual physical limitations but as a consequence of complex interactions between physical, social and institutional parameters within the environment, one lives in. However, these research studies have mostly catered to the urban settings of the developed nations which is contextually quite different from the rural settings of the developing nations. Very little work has been documented with regard to study interactions between people with disabilities in the rural environments in the developing nations and hence lacks theoretical advancements and defined methodologies.

It thus becomes important to review the representative works in the field of disability and environmental relationships to gain understanding about the definitions, existing theories

and methodological processes. This shall enable the researcher to highlight research gaps in the area which could be further dealt with for advancing research. The work presented ahead has been reviewed and distributed in the following domains of understanding disability, environmental barriers, rural context, design theories and assistive technology.

2.2 UNDERSTANDING DISABILITY

2.2.1 Definitions

Defining disability is complex and controversial. Though arising from physical or intellectual impairment, disability has social as well as health implications. A full understanding of disability recognizes that it has a powerful human rights dimension and is often associated with social exclusion, and increased exposure and vulnerability to poverty. Disability is the outcome of complex interactions between the functional limitations arising from a person's physical, intellectual or mental condition and the social & physical environment. It has multiple dimensions and is far more than an individual health or medical problem. Disability as a term has diverse perceptions by individuals and institutions across the world. India with a large stretch of diversity also faces the same situation which leads to an inconsistent approach.

Finkelstein, V (1976) in his document, *Fundamental Principles of Disability,* defined disability as the disadvantage or restriction of activity caused by a contemporary social organization which takes no or little account of people who have physical impairments.

Nichols, PJR (1976) stated that there is no such concept of stable disability. Explaining through an example, he noted, that if a child may be born without a forearm and hand and technically has a stable disability, it will present different problems with the growth of the child. His demands upon his limbs will change and his attitudes towards his physical disability change, and interaction between the environment and the child as a person and the disability are all changing.

The International Classification of Impairments, Disabilities and Handicaps (ICIDH) provides a framework for defining and classifying information about the long term consequences of disease, injuries or disorders' (WHO 1980).

An *Impairment* is defined as 'any loss or abnormality of psychological, physiological or anatomical structure or function.'

Disability, is defined as 'any restriction or lack of ability (resulting from an impairment) to perform an activity in the manner or within the range considered normal for a human being.'

Handicap, is defined as 'a disadvantage for a given individual, resulting from an impairment or a disability, that limits or prevents the fulfillment of a role that is normal (depending on age, sex, and social & cultural factors) for that individual.'

However, ICIDH-2 proposes the revised framework to incorporate new developments and criticisms of the original ICIDH. In the revised framework, the term, 'disablement' is used as an 'umbrella' term to encompass the universe of disability experience, including three basic dimensions: Impairment, Activity, and Participation. While impairment carries the same definition as above, the proposed definitions of *Activity* and *Participation* are as follows:

Activity, is the nature and extent of functioning at the level of the person. Activities may be limited in nature, duration and quality.

Participation is the nature and extent of a person's involvement in life situations in relationship to impairments, activities, health conditions and contextual factors. Participation may be restricted in nature, duration and quality (WHO, 1997). An interaction of these concepts as shown in Fig.2.1, highlights the role of environmental factors in addition to the personal factors.

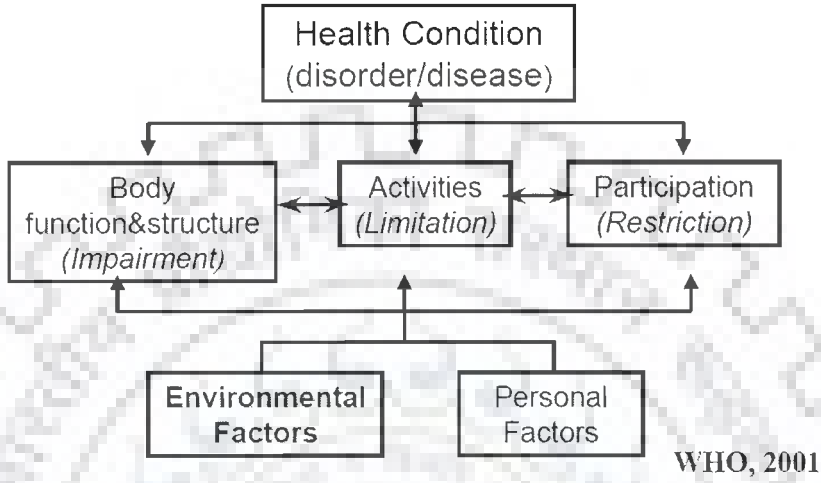


Fig.2.1 Interaction of Concepts

Physical disability and the use of a mobility aid limit various functions related to physical work capacity, namely reach, output of force, speed of movement, static and dynamic balance, mastery of step obstacles, and the use of both hands in materials handling (Petzall, J., 1996; Nowak, E., 1996; Puranen, N N, 1997).

Reuterswärd, L (1995) stated that in developing countries more than one person in ten has a physical or sensory impairment. However, only when an impairment prevents an individual from fulfilling a "normal" role in society, does he or she become "handicapped." While proposing an argument that one should think instead of their abilities, he suggested that the integration of the impaired into society gives both social and economic gains, and it also promotes social equity.

Danford, et al (1999) asserts that physical environment alone is sufficient to exhibit any of these conditions – impairment, disability, or handicap. As defined by the World Health

Organisation (WHO, 1980) the medical version of disability involves three concepts, 'impairment', 'disability' and 'handicap'.

Handicap reflects the interaction between disability and environmental factors (i.e. the physical and social characteristics of a person's environment). It is defined as 'a disadvantage for a given individual, resulting from an impairment or a disability, that limits or prevents the fulfillment of a role that is normal.

Disability is not a fixed state that can be objectively measured, but its parameters vary from one culture or environment to another (Stubbs, 2002). Cross-cultural differences in the interpretation of disability show that the lives of people with disabilities are made more difficult, not so much by their specific impairment, as by the way society interprets and reacts to disability (DFID, 2000).

Disability is viewed as an inability or limitation in performing a task and has a locus in the individual; handicap, or the positive and easier to measure term "participation," is an outcome of the interaction between the person and the sociophysical environment. It has a locus in the environment. A disability is viewed as the functional limitation caused by an impairment, whereas lack of participation is caused by the response of a culture to disability (Steindeld, E., *et al*, 1999).

2.2.2 Models of Disablement Process

The traditional model views impairment, disability and handicap as a linear cause-and-effect process; that is, impairment causes disability and disability in turn leads to limitations in societal participation or "handicap" (Fig. 2.2). Focusing primarily on the person (individual with disability), traditional theory has stigmatizing implications. With an objective to reduce handicap and increase societal participation through environmental design, most researches on the relationship of the physical environment

to disablement has focused on the development of normative guidelines for ensuring access to the built environment (Steinfeld, E., *et al*, 1999).

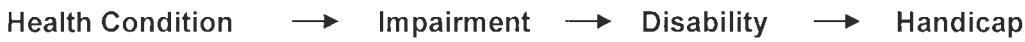


Fig.2.2 Traditional Model of Disablement Process

Based on the premise to reflect real world conditions involving personal and environmental factors, ICIDH underwent a revision to propose the new conception of the disablement process (Fig. 2.3). The new model conceptualizes environment as a disabling or enabling context in both functional ability and social participation. It deflects in its approach from individual limitations to lay emphasis on the environment and bringing attention to the limitations in the context of daily life.

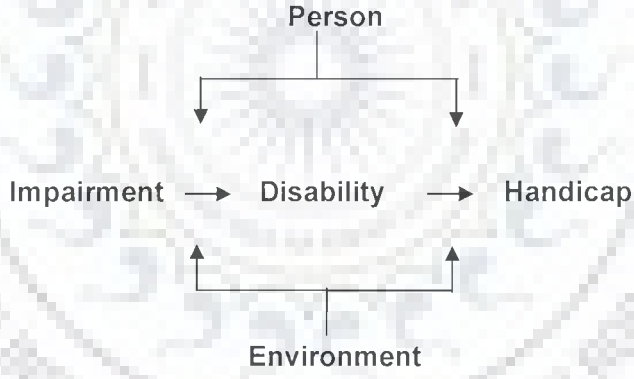


Fig. 2.3 New Conception of the Disablement Process

The social model perspective incorporates research that examines problems of quality of life, user satisfaction, participation, and accessibility of various domains of the environment (Seelman, K., 2004). Steinfeld, *et al* (1999) explains the critical role of environment in the social construction model of disability. He explains, although restrictions on participation may be caused by social barriers such as policies and attitudes that lead to inaccessible places, the physical environment can also be viewed as part of the disability because it has a direct relationship to functional performance.

(Gray,D., 2004) The amount of disability is not determined by levels of pathologies, impairments or functional limitations but instead is a function of the kind of services provided to people with disabling conditions and the extent to which the physical, built environment is accommodating or not accommodating to the particular disabling condition. (Brandt and Pope, 1997)

Gray, D. (2004) illustrated the social ecology of people with mobility impairments and limitations. Fig. 2.4 shows the restricted niche of homo situs (mobility impaired and limited) existing as a part of the larger niche of homo sapiens, while Fig. 2.5 illustrates the expansion of the niche of homo situs in response to the receptivity of the environment in which these people are present.

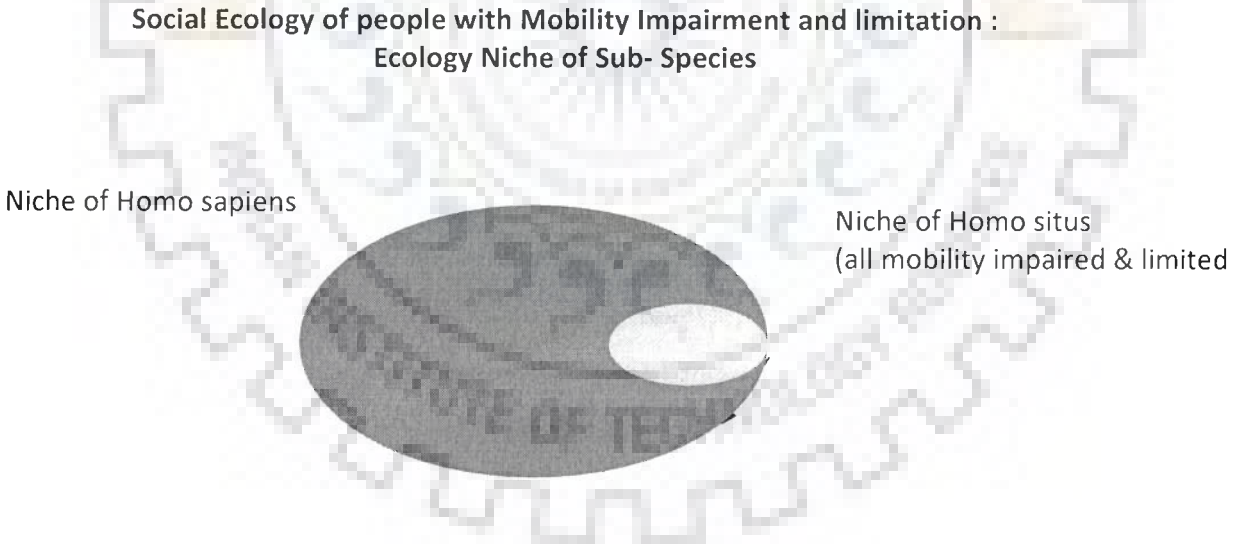


Fig. 2.4 Niche of mobility impaired & limited with respective environment AT , PAS , Accessible , Universal design , Positive , Social attitudes and policies

Expansion of Ecological Niche of Sub-Species Homo situs by Receptive Environment

Niche of Homo sapiens

Niche of Homo situs (mobility impaired &limited)

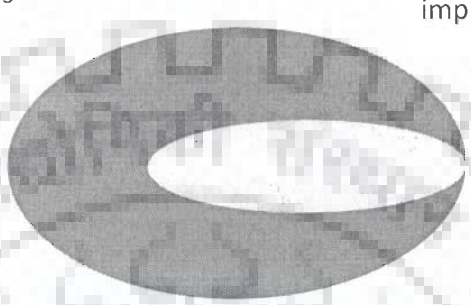


Fig. 2.5 Niche of mobility impaired & limited with respective environment AT, PAS , Accessible , Universal design , Positive , Social attitudes and policies

Oliver, Mike (1982) was the first commentator to articulate and define the social model, in a paper published in March, 1982.

Goldsmith, S (1996) describes Architectural disability as a version of the social model of disability. He further iterates that medical disability and architectural disability do not have a straight correlation. He points out that architectural disability is not exclusive to medically disabled people. The people it affects are not therefore a discrete population, and they cannot be scored and counted as being disabled. In his opinion, Architectural disability is in effect, synonymous with architectural discrimination, the principle being that a building user can be discriminated against on account of a building feature that is disabling.

Goldsmith, while suggesting the role of an architect as a preventive therapist, defined architectural disablement as follows:

"An architecturally disabled person is a person who, when using or seeking to use a building, is confronted by an impediment which would not have been there, or would not have been so irksome, had the architect who designed the building done so in a way which was responsive to his or her particular needs."

Further, he defined the complementary concept of architectural enablement as follows: "An architecturally enabled person is a person who, when using a building, is able to do so on account of a building feature or features without which he would not have been able to use that building , or to do so conveniently."

He stated, 'Among people with medical disabilities it is those with a locomotor disability- ambulant disabled people and wheelchair users- who are most vulnerable to disablement when using public buildings, and whom the architect, as enabler, can most effectively help.'

Imrie,R., *et al* (2002) compared the various models of disabilities in the tabulated format as given below :

Table 2.1 Models of Disability : A Comparison [*Source : Imrie, R,. et al, 2002*]

Medical	**Social**	**Bio-Social**
Personal tragedy theory	Social oppression theory	Bio social theory
Personal Problem	Social Problem	Personal /Social problems
Individual Treatment	Social action	Individual / social action
Medicalisation	Self help	Medical/self help
Professional dominance	Individual/ collective responsibility	Collective responsibilities
Expertise	Experience	Expert/ lay experiences
Individual identity	Collective identity	Individual /collective identities

Prejudice	Discrimination	Prejudice/discrimination
Care	Rights	Care combined with rights
Control	Choice	Control combined with choice
Policy	Politics	Political and policy change
Individual adjustment	Social Change	Individual adjustment and social change

Bio-sociological approaches to disability, as they are termed, are in their infancy but are an attempt to move beyond the duality of the social and medical models of disability by seeking to interconnect them in ways which recognize the complex interactions between physiology, culture and wider socio economic and political relationships. The emergence of bio social perspectives underpins recent changes to the WHO's (1999) classification of impairments, disabilities and handicaps.

WHO (1999:25) notes, ICIDH-2 is based on an integration of these two extreme models. In order to capture the integration of the various dimensions of functioning, a bio-psychosocial approach is used...to achieve a synthesis thereby providing a coherent view of different dimensions of health at biological, individual and social levels.

Finkelstein, V. (1998) argues and points at the lacunae in the community perspectives of disability. He points out, "What is perhaps not fully appreciated in the community of disabled people is that during the past two decades our agitation about the 'individual' and 'social' models of disability etc., is not merely an internal discussion about the way 'disability' is understood and interventions arranged, but an argument about the nature of all human beings - the essentials of being human".

The social model of disability identifies three major types of discrimination:

1. Institutional discrimination;
2. Environmental discrimination; and

3. Attitudinal discrimination.

2.2.3 Locomotor Disabilities – Its causes and impact

Mobility is the key to Activities of Daily Living for physically disabled (Nichols, PJR). Locomotion refers to the act, ability or power of moving, and will be taken in the context of this research, to include biomechanical operations such as walking, standing, reaching and bending. Causes of locomotor disability are diverse though commonly result from road traffic accidents, industrial accidents, degenerative neuronal disease, congenital and inherited deformity, cerebro-vascular disease (strokes) and particularly in India infective disease (e.g. Polio).

Poliomyelitis (Polio) is a highly infectious virus disease that affects the central nervous system mainly in children under the age of three years, and is still a very common cause of locomotor disability in India. The virus is excreted and therefore is prevalent in places with poor hygiene, and its symptoms normally appear 7-10 days after infection. There are four main types of the virus:

1.**Abortive poliomyelitis:** there is no paralysis in abortive poliomyelitis and only the throat and intestines are infected. The symptoms are similar to flu.

2.**Nonparalytic poliomyelitis:** in this variety the symptoms are similar to the above, but accompanied with stiff muscles, particularly in the neck and back.

3.**Paralytic poliomyelitis**: paralytic poliomyelitis is much less common. Again the symptoms are similar to both the above, but muscle weakness and eventually paralysis occur.

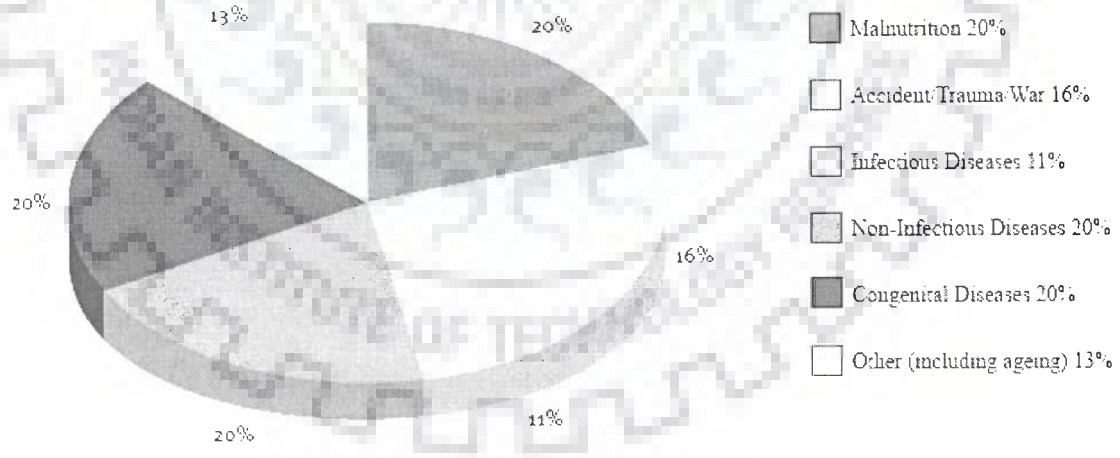
4.**Bulbar poliomyelitis:** Similar symptoms to the above occur, however in this type muscles in the respiratory system are affected, which can impinge on breathing.

The paralysis resulting from polio is identified as acute flaccid paralysis (AFP) and often occurs in one leg, though sometimes it affects both, as well as the arms, trunk, and upper

body. There is no cure for polio, however immunization is highly affective using either the Sabin or Salk vaccine (Kundu, C.L., 2000, Cochrane, M., 2002).

The number of polio disabled people in India is quite colossal. A 1994 World Health Organisation (WHO) report on global situation on polio estimated that of the 10 million people affected with polio, approximately 60% live in India alone. India is a country in which polio is endemic and accounts for over 50% of polio cases reported worldwide (Banerjee *et al.*, 2000).

The most common causes of motor disability are injuries from accidents on the road, at home, or the workplace; war and violence, including landmines; birth trauma; and infectious diseases such as polio and leprosy. Children are often disabled as a result of malnutrition (Fig.2.6).



Source: UN Figures in *Overcoming Obstacles to the Integration of Disabled People*, UNESCO, DAA, March 1995

Fig. 2.6 Causes of Impairment
Source : DFID, 2000

On the basis of mobility locomotor disabilities could be categorized as ambulant and non ambulant. Ambulant disabled are those, who are able to walk with or without an assistive

device, while non ambulant disabled are those who have a complete loss of mobility and are thus either chair bound or require complete assistance to be lifted or crawl for mobility needs. This classification is important from the perspective of understanding their limitations in the performance of Activities of Daily Living.

2.2.3.1 International Perspective

Goldsmith, S (1976) notes, among people with medical disabilities it is those with a locomotor disability – ambulant disabled people and wheelchair users – who are most vulnerable to disablement when using public buildings and whom the architect, as enabler, can most effectively help.

Lavery, I. *et al*(1996) reviewed the status of mobility impaired in Europe and found that atleast 10% of any population has some degree of mobility problems which makes it difficult, if not impossible, for them to use conventional public transport. This 10% should be considered to be a minimum figure e.g. the figure for disability in Great Britain is 14.2% but in Wales and Northern Ireland the figures are 17.0% and 17.5%, respectively. He further reported, mobility-impaired people have a wide variety of functional impairments and it should be noted that only 2-3% of disabled people are in wheelchairs. Many people with mobility problems do not wish to be classed under de-personalizing terms as 'disabled' or 'handicapped' and sometimes they are reluctant to disclose that they have mobility problems.

2.2.3.2 Indian Perspective

Locomotor Disability is defined as a person's inability to execute distinctive activities associated with moving, both personally and objects, from place to place, and such inability resulting from afflictions of musculoskeletal and/or nervous system. It can be classified as : *congenital* and *acquired*. Causes for the acquired disability can be bracketed into two domains : *Infective* and *Traumatic*. The infective ones are: tuberculosis of spine or other joints, septic arthritis, acute poliomyelitis, leprosy etc. while the traumatic ones are : traffic accidents, domestic accidents, industrial accidents, agricultural accidents, bullet injuries, burns, natural catastrophes like earthquakes, floods etc. Beyond the above listed categories, there could be miscellaneous causes as muscular dystrophy, lathyrism, rheumatoid arthritis.

2.2.4 Disability and Poverty

A UNESCO study has shown that, worldwide, the most common form of employment for individuals with disability resulting from these conditions is begging (Helander, 1993).The poverty trap has put developing countries on a constant struggle which requires them to generate resources to set up such services in the first place, in order to get out of it. According to Sandhu, J.S., *et* al (2001), the potential impact of universal design in these circumstances could be immense.

It is reported that, disability exacerbates poverty, by increasing isolation and economic strain, not just for the individual but often for the affected family as well. Children with disabilities are more likely to die young, or be neglected, malnourished and poor.

People with disabilities who are denied education are then unable to find employment, driving them more deeply into poverty. It is found that it becomes more and more difficult to break out of the vicious cycle of poverty and disability (Fig. 2.7). As a result, people with disabilities are amongst the poorest of the poor and their literacy rates are considerably lower than the rest of the population. DFID (2000) reported that as many as 50% of disabilities are preventable and directly linked to poverty.

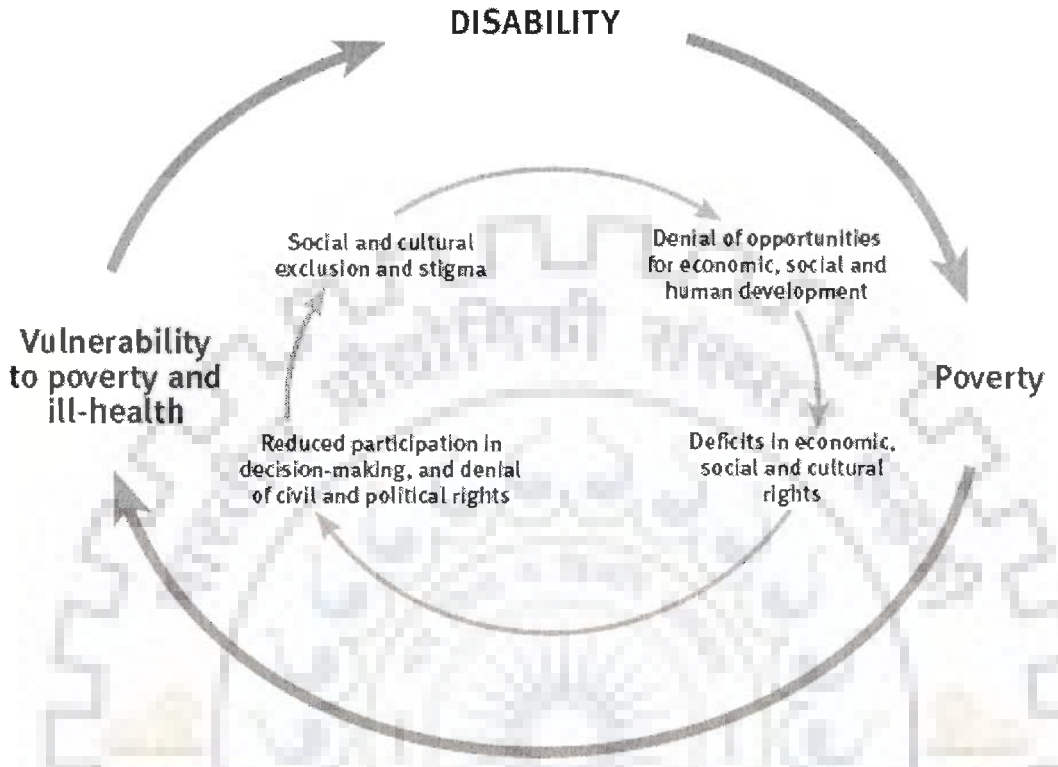


Fig. 2.7 Poverty and Disability : a vicious cycle
Source : DFID, 2000

Women with disabilities suffer a double discrimination, both on the grounds of gender and of impairment; their literacy rates are lower than their male counterparts. Recent UNESCO studies have suggested that only 1–2% of children with disabilities in developing countries receive an education.

According to a study of disability in India by Erb, S. *et al* (1999), 'At least 32 million people were likely to be disabled in 1991, and the lives of their families, those people affected indirectly by disability amount to perhaps four to five times as many; 130 million. ...These figures are likely to be great underestimates'.

Gupta, S. *et al* (2001) reported, " There is a very cynical relationship between poverty and disability; poor people tend to become disabled because of their living conditions, which makes them even poorer." She comments, "Not being able to cater to this majority with the benefit of inclusive design will be a pity." According to the UN reports, only 3% of the disabled population in India receives rehabilitation aids. She reported, this is because of the high cost of the mobility aids and also because they may not be culturally suited for these areas. They quote an example saying, " One can see an ordinary wheelchair being used as a wheelbarrow to cart sacks of grain as the roads are unpaved and also a wheelchair may not go through the main door due to inaccessibility."

There appears to be a very close correlation between disability and poverty in the developing world (Shirley, 1983). Usually disability does not only guarantee the poverty of the victim but, most importantly, poverty is the major cause of disability (Doyal & Pennell, 1979). Also, the poor are the least likely to have access to medical and rehabilitative services. The World Health Organization (WHO) reports that rehabilitative services in the developing world reach only 1 to 2% of the disabled population (Frye, 1993).

Poverty increases the likelihood of being disabled : in South Africa, poor living conditions and difficulties with activities of daily living were found to be relocated (Taunyane and Hirschowitz, 1995). It is also observed that poverty makes it more difficult for families to minimize the impact of an impairment and families lack the resources to access the care and rehabilitation, including assistive devices, that disabled family members need (May-Teerink, 1999; Taunyane and Hirschowitz, 1995; Radda Barnen et al, 1998). The lost earning opportunities of carers also increase the burden on poor families (Helander, 1999).

The UN estimates that 25% of the entire population is adversely affected in one way or another as a result of disabilities (Despuoy, L., 1993). The cost of disability has three components (Erb, S. *et al*, 1999) :

1. the direct cost of treatment, including the costs of travel and access;
2. the indirect costs to those who are not directly affected ('carers');
3. the opportunity costs of income foregone from incapacity.

Wolfenson (2002) recommends to encourage appropriate design standards as an essential tool in reducing, and eventually eliminating, poverty in developing countries. Jones, H.E., *et al* (2003) concluded in her paper, "By mainstreaming disability considerations, we can make a huge contribution to reducing poverty, and improving the health, dignity and well-being of a marginalized but ever more vocal social group."

2.2.5 Measuring Person – Environment Interactions

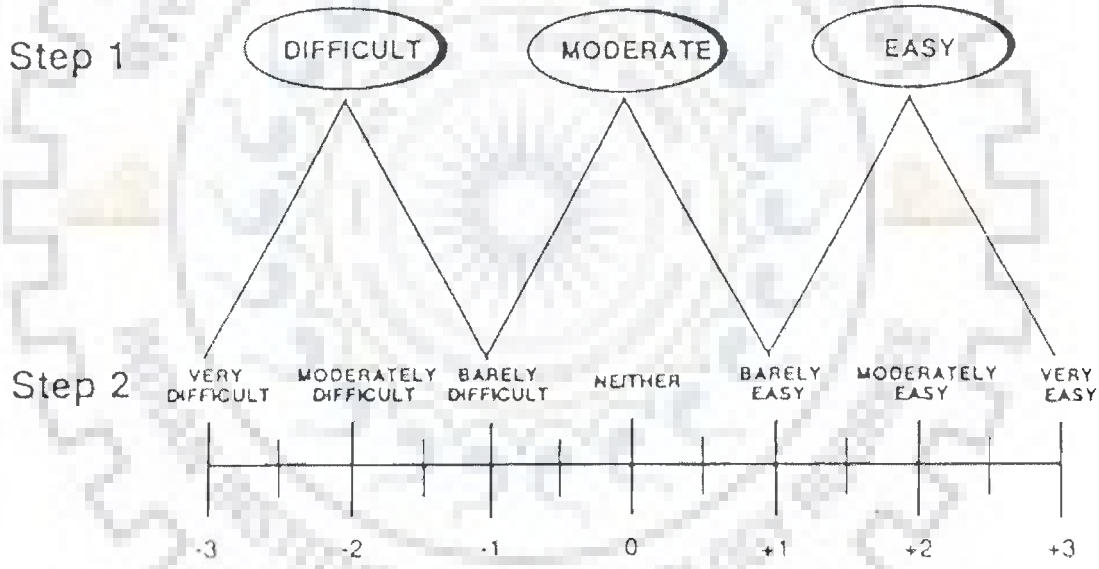
To assess degree of disability, to characterize health status and to measure rehabilitation outcomes, measures of functional assessment have been developed over several decades (ICIDH-2). Two basic measures of activity limitation, the Activities of Daily Living (ADL) scale and the Instrumental Activities of Daily Living (IADL) scale, have been widely used in clinical settings and population surveys to define disability and to assess need for services. Self reporting or professional assessment are the two modes of collecting information using these scales. The ADL scale focuses on assessing ability to perform basic self care activities For e.g. bathing, toileting etc. The IADL scale assesses ability to carry out activities central to independent functioning in community.

The physical environment has always been recognized as an important variable affecting rehabilitation outcome. Lack of reliable tools to measure environmental impacts coupled with lack of theoretical developments in the area, hampered development of both research and clinical methodology (Steinfeld, et al, 1999). To improve reliability and validity of research and clinical interventions, methodological developments are gaining greater emphasis. Several methods were developed to operationalize the measurement of fit between person-environment. The two levels of measurements include, functional

ability (at a finer level than FIM™) and global measure of independence. Some of the methods were reviewed and are discussed as follows :

Usability Rating Scale™

The Usability Rating Scale (URS™) was developed to measure the subjective responses of an individual's experience during the functional performance of activities in physical environments through a two step process (Fig. 2.8). It is originally derived from the Pitrella – Kappler scale (1988) which follows a two step sequential process with 14 anchor points for greater sensitivity. The greatest advantage of URS™ as survey instrument has been low costs of its administration compared to observer ratings. Its simplification to a



7-point bi polar rating resulted from the responses by the subjects under investigation.

Fig. 2.8 Two step Usability Rating Scale (URS™)
Source:Danford, G S and Steinfeld, E., 1999

Danford, G.S., *et al*(1999) concluded through his paper on the influence of physical environments that the measurement of the mediating influence of environments on the behavior of people with impairments can enable the diagnosis of disabling and handicapping person – behavior – environment relationships. He further states,

"Environmental design can then become a more effective form of intervention as part of the rehabilitation practice."

Functional Independence Measure™

Hetherington, H. *et al* (1995) noted in their paper that the quantification of mortality is simple, but measurement of disability is difficult. They discussed the use of FIM™ (Functional Independence Measure) as a measurement tool to measure the disability status of injured patients for giving rehabilitative services in health care settings.

Following advantages of the FIM scale were listed by them for the health care settings:

(I) helps to co-ordinate medical and therapy efforts;

(2) establishes a method of monitoring progress;

(3) offers a measurement against which goals can be established;

(4) provides a basis for allocating resources for the different therapists;

(5) aids the planning of discharge policies;

(6) helps to identify potential rehabilitation problems;

(7) facilitates the measurement and monitoring of disability specifically in the long-term head and spinal injury patients;

(8) acts as a useful measurement of progress for the family and the patient himself.

They further pointed out that disability and handicap are terms often used interchangeably, but they should be viewed as quite separate entities. Handicap is more difficult to measure since it covers both the individual's adaptation to his environment and also society's inability to adapt to the individual, both locally and nationally. Consequently the practical result is that most people concentrate on disability rather than handicap measurement.

The FIM™ instrument measures disability in terms of functional limitation (Fig. 2.9). It is based on the theory that disability can be measured separately from the influence of the environment.

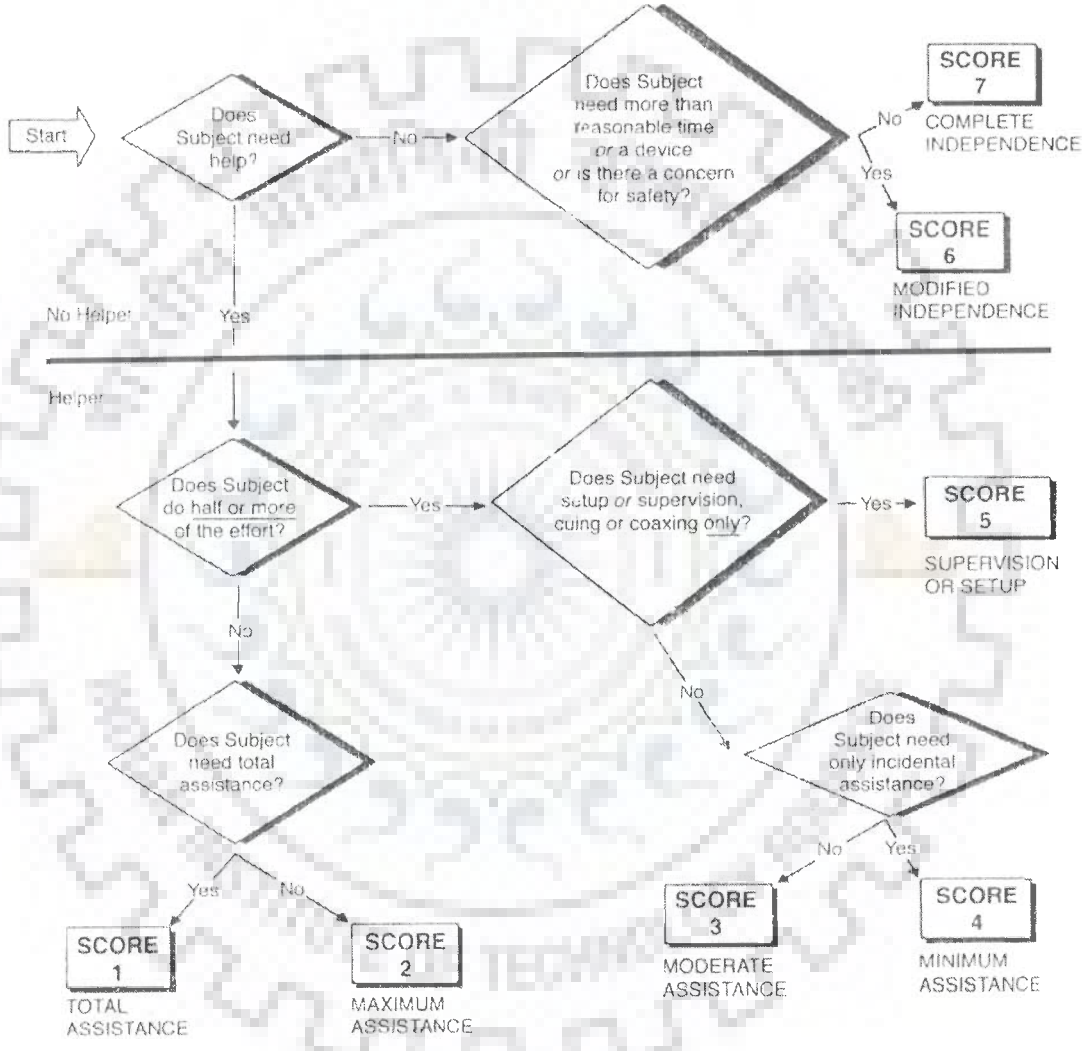


Fig. 2.9 Decision Tree for Functional Independence Measure (FIM™)
Source: Danford, G S and Steinfeld, E., 1999

Enviro- FIM™

Derived from the FIM™, Enviro FIM™ is a 11 point observer rating scale to evaluate design artifacts in terms of their impact on the functional independence of an individual or a group. It also enables a global assessment of fit between subjects and designed physical environments through determining the mismatch between environment's demand character and a subject's mastery level. However, it requires a trained observer for its administration.

Functional Performance Measure

The Functional Performance Measure (FPM™) employs two observer rating scales to score the *level of effort* expended by the subject towards task performance and the *level of assistance provided* by a caregiver. While Enviro FIM™ instrument implies a continuum between degree of independence and assistance, FPM™ scale separates the measurement of individual performance from assistance. It highlights the concept that caregiver burden may vary independently from the effort of the individual receiving care. FPM™ could thus be used to identify the needed design changes in specific task environments that will improve the subsequent task performance. It also requires a trained observer for its administration and videotaped records are needed to do the detailed analysis required.

The Enabler

Jensen, G., *et al* (2001) reported that there is a shortage of valid and reliable methods in order to assess accessibility, i.e. the relationship between functional capacity and environmental demands. They then refer to the Enabler Concept, which was developed with a notion that accessibility is a relative construct and remains a starting point for the development of methods for accessibility assessments. They further note that while planning an accessible environments or making a general assessment of how accessible a

given environment is, the degree of accessibility problems cannot be predicted unless the environmental design is related to the context of functional limitations.

The Enabler Concept is originally an American idea (Steinfeld et al., 1979), with a design operationalizing person-environment (P-E) fit in terms of functional capacity (personal component) and environmental demands (environmental component) (Iwarsson, 1997; Jensen, Iwarsson & Ståhl, 2002). It can be applied with great flexibility and is thus suitable for assessment tasks from various perspectives.

Full Scale Modelling

Steinfeld, E., *et al* (2003) demonstrated the successful use of full scale modeling to measure functional abilities and obtain data on outcomes of fit between environments and a person's abilities. He extends to say that conventional anthropometric measurements do not provide complete information with respect to measuring person – environment interactions. To study the environmental interactions, not only are physical factors critical in determining this interactive effect, but also, psychological and social variables come into play, including motivation, perception, cognition, social norms, self-concept and social interaction distances (Danford and Steinfeld, 1999).

The above mentioned scales and measurement tools facilitate an objective measurement of the person-environment fit. Some of them independently measure individual limitations or assess functional capacity while others measure the environmental demand and burden on the caregiver. However, it is important to note, these scales have been developed for clinical, rehabilitation or controlled environment (lab based) settings, wherein the other biases could be removed.

2.2.6 Rehabilitation Engineering

Nichols, PJR (1976) One field in which engineers and ergonomists are particularly interested is in the design and use of artificial limbs. It is worth reiterating that over 60%

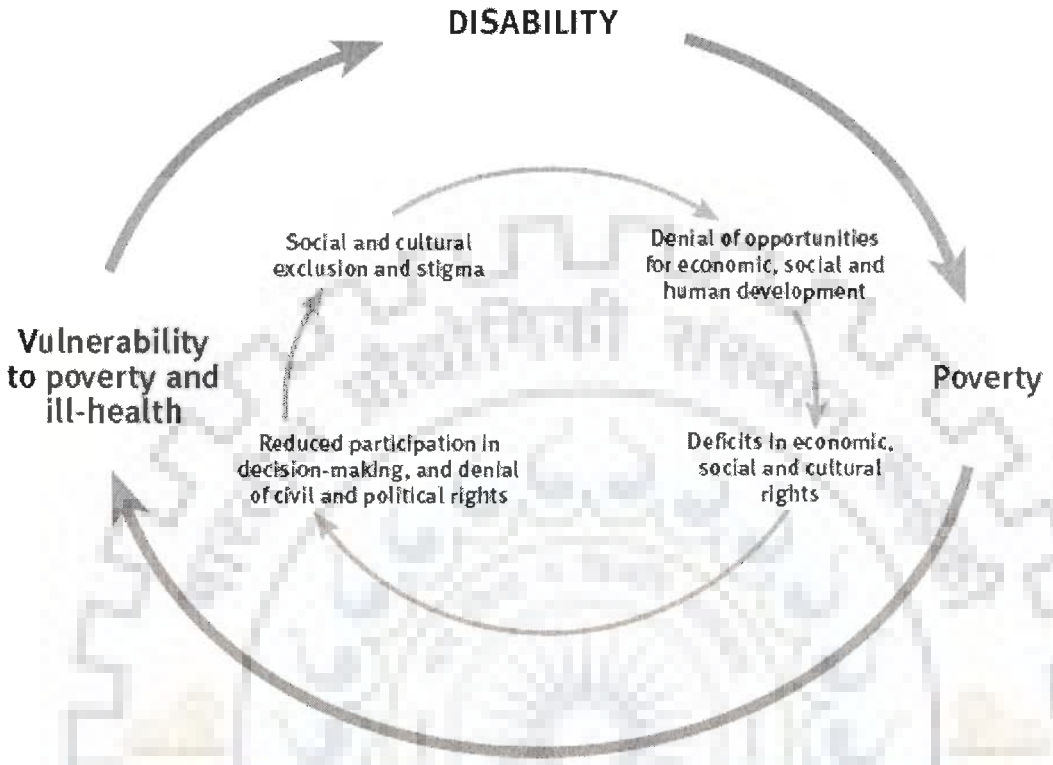


Fig. 2.7 Poverty and Disability : a vicious cycle
Source : DFID, 2000

Women with disabilities suffer a double discrimination, both on the grounds of gender and of impairment; their literacy rates are lower than their male counterparts. Recent UNESCO studies have suggested that only 1–2% of children with disabilities in developing countries receive an education.

According to a study of disability in India by Erb, S. *et al* (1999), 'At least 32 million people were likely to be disabled in 1991, and the lives of their families, those people affected indirectly by disability amount to perhaps four to five times as many; 130 million. ...These figures are likely to be great underestimates'.

of all amputees in the United Kingdom have their limbs amputated for progressive vascular disease of the lower limbs and are in the elderly age group.

It is estimated that only 2% of people with disabilities in developing countries have access to rehabilitation and appropriate basic services (Despouy, L., 1993).

The rehabilitation process and the design of the limbs should be regarded as a separate problem in the two quite different sets of circumstances. The young man wants a tough, reliable prosthesis backed up by good servicing facilities and usually a second prosthesis so that he is never without the device if anything happens to go wrong If he has an above knee amputation he usually requires some form of knee mechanism to allow easy swing-through and a more natural movement. The elderly person needs something light, stable, simple to put on and take off, of acceptable cosmetic appearance.

Finkelstein, V. (1981) while raising the issue of resource based rehabilitation said, If society, through the technological revolution, now has the means to reintegrate its disabled people and if, as disabled people are saying, integration means taking control over one's own life and if disabled people do need continuing assistance from others then the basis of the future helper/helped relationship has to undergo profound transformation.

Vastmans,R. (2001) stated, that the new technology era provides an enormous worldwide inclusive potential and challenge to ameliorate the living conditions of mankind and for everybody. He concludes that universal human values must be safeguarded by existing institutions, governments and the representative non-governmental organizations, e.g. of the disabled, taking into account the tradition, culture, the social and economic network, the standard of living within the respective states and countries.

of all amputees in the United Kingdom have their limbs amputated for progressive vascular disease of the lower limbs and are in the elderly age group.

It is estimated that only 2% of people with disabilities in developing countries have access to rehabilitation and appropriate basic services (Despouy, L., 1993).

The rehabilitation process and the design of the limbs should be regarded as a separate problem in the two quite different sets of circumstances. The young man wants a tough, reliable prosthesis backed up by good servicing facilities and usually a second prosthesis so that he is never without the device if anything happens to go wrong If he has an above knee amputation he usually requires some form of knee mechanism to allow easy swing-through and a more natural movement. The elderly person needs something light, stable, simple to put on and take off, of acceptable cosmetic appearance.

Finkelstein, V. (1981) while raising the issue of resource based rehabilitation said, If society, through the technological revolution, now has the means to reintegrate its disabled people and if, as disabled people are saying, integration means taking control over one's own life and if disabled people do need continuing assistance from others then the basis of the future helper/helped relationship has to undergo profound transformation.

Vastmans,R. (2001) stated, that the new technology era provides an enormous worldwide inclusive potential and challenge to ameliorate the living conditions of mankind and for everybody. He concludes that universal human values must be safeguarded by existing institutions, governments and the representative non-governmental organizations, e.g. of the disabled, taking into account the tradition, culture, the social and economic network, the standard of living within the respective states and countries.

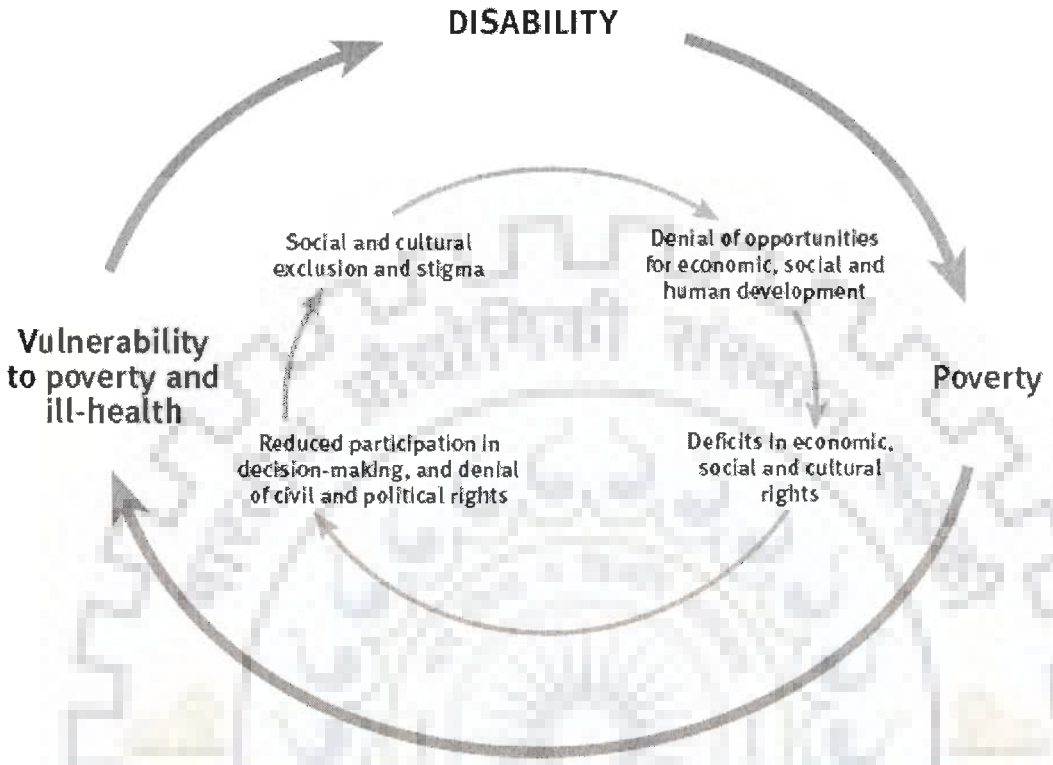


Fig. 2.7 Poverty and Disability : a vicious cycle
Source : DFID, 2000

Women with disabilities suffer a double discrimination, both on the grounds of gender and of impairment; their literacy rates are lower than their male counterparts. Recent UNESCO studies have suggested that only 1–2% of children with disabilities in developing countries receive an education.

According to a study of disability in India by Erb, S. *et al* (1999), 'At least 32 million people were likely to be disabled in 1991, and the lives of their families, those people affected indirectly by disability amount to perhaps four to five times as many; 130 million. ...These figures are likely to be great underestimates'.

of all amputees in the United Kingdom have their limbs amputated for progressive vascular disease of the lower limbs and are in the elderly age group.

It is estimated that only 2% of people with disabilities in developing countries have access to rehabilitation and appropriate basic services (Despouy, L., 1993).

The rehabilitation process and the design of the limbs should be regarded as a separate problem in the two quite different sets of circumstances. The young man wants a tough, reliable prosthesis backed up by good servicing facilities and usually a second prosthesis so that he is never without the device if anything happens to go wrong If he has an above knee amputation he usually requires some form of knee mechanism to allow easy swing-through and a more natural movement. The elderly person needs something light, stable, simple to put on and take off, of acceptable cosmetic appearance.

Finkelstein, V. (1981) while raising the issue of resource based rehabilitation said, If society, through the technological revolution, now has the means to reintegrate its disabled people and if, as disabled people are saying, integration means taking control over one's own life and if disabled people do need continuing assistance from others then the basis of the future helper/helped relationship has to undergo profound transformation.

Vastmans,R. (2001) stated, that the new technology era provides an enormous worldwide inclusive potential and challenge to ameliorate the living conditions of mankind and for everybody. He concludes that universal human values must be safeguarded by existing institutions, governments and the representative non-governmental organizations, e.g. of the disabled, taking into account the tradition, culture, the social and economic network, the standard of living within the respective states and countries.

CBR attempts to combine physical rehabilitation through medical care with empowerment and social inclusion through the participation of both the individual with a disability and the community in the process of rehabilitation. CBR is often claimed to be the best approach to inclusion and social integration, and an effective means of making the best use of scarce resources. The WHO believes that it promotes and protects human rights while also creating equal opportunities and making the best use of scarce resources (DFID, 2000).

Rehabilitation takes place within the community and is fully participatory. Community members (both with and without disabilities) are the most important resources. CBR depends heavily on the development of positive attitudes and approaches among the people involved. Active community support is vital for its success.

In rural areas, community-based rehabilitation programmes assist in the integration of people with disabilities into employment and the community (Pal, D.K. *et al*, 2002). CBR is a low cost approach towards meeting the needs of people with disabilities and their families in developing countries (Helander, Mendis, & Nelson, 1983). CBR relies on largely non-technical methods and personnel and aims to enable people with disabilities to achieve social integration, equalization of opportunity and economic self-reliance (Joint Position Paper, 1994).

2.3 BARRIERS TO ACCESS

Barrier is 'any obstacle or circumstance that hinders or obstructs progress, access, etc.' (Oxford Advanced Learner's Dictionary) thereby implying a literal and a figurative extension of its meaning.

Salvage, A. et al (1995) while referring the built environment of Britain describes it as hostile as it has been designed without taking into account the needs of mobility

impaired. Goldsmith (1976) observed, "Buildings always have been and always will be, geared to suit two legged able bodied people and not people propped on sticks or rolling about in chairs on wheels."

Sutherland, A.T. (1981) stated, "It is widely assumed that most disabilities impose considerable restrictions, such as lack of mobility, limitations in finding and holding employment, isolation and difficulty in integrating with able bodied people. People with disabilities do have to face all of these restrictions, and others, but such restrictions are not imposed by their disabilities. They are imposed by a society which discriminates against people with disabilities, creating restrictions by denying people the means to exercise their capabilities."

He further pointed that access is the most obvious area of discrimination, particularly for people with disabilities that affect their mobility. To experience the extent of this discrimination, one has to just walk on the street.

Puranen, N N (1999) points out, 'Barriers to employment for disabled persons can either be physical or attitudinal (5). Physical barriers include inaccessible workstations and an inability to perform required work tasks without modification of the work environment.

Sandhu, J.S., *et al* (2001) Lessons from developing countries corroborate that social inclusion, equal opportunities, and mainstreaming are integral to universal design. From, his experience of developing countries around the world, he identified six major barriers to the enjoyment of full human rights by marginalized groups in these countries:

1. Hostile attitudes by officials and "ignorant" members of the public.
2. Lack of resources and institutional capacity.
3. Lack of enforcement. Although there are laws and regulations, there is often neither money nor the will to ensure that they are enforced.
4. Urban emphasis in activities, leaving large tracts of the countryside uncovered.

5. Environmental barriers that make it extremely difficult for citizens, especially those with a disability, to access services in both urban and rural areas.
6. Inadequate services in health care, education, training, and rehabilitation.

On the analysis of available information and opinion, Jones, H.E. *et al* (2003) found, that disabled people in low income communities routinely face exclusion by water and sanitation projects, primarily due to external barriers – in the environment, infrastructure and institutional practices, rather than to disabled people's own limitations. International agencies now recognize that disabled people's participation is affected not only by their individual limitations, but also by the physical barriers in the environment, ' a complex of cultural, social and economic rules' (UNESCAP,1995a) and 'societal barriers' (WHO,2002).

2.3.1 Individual Limitations

'Physical weakness means that disabled people have to rely on stronger household members to collect water for them, or to wash themselves, their children, clothes, dishes, etc. at communal water places.' (Van der Kroft, 2002).

Mulholland, et al (1998) studied a group of ten disabled women with physical impairments in India with the aim of understanding their day to day mobility needs. Nine of the ten were able to access toilet and bathing facilities with varying degrees of difficulty, and they had difficulty in fetching water, because of the distance involved and their difficulty in transporting objects.

Pain is identified as a limiting factor in carrying out daily activities by the physically disabled children in Nepal (Boyce, et al, 2000). Mulholland, et al (1998) found that among a group of Indian women with physical impairments, pain in limbs or joints cause problems, and discomfort from the ground being too hot or cold on their hands or legs.

Cultural behavioural norms also impose functional limitations. In Asia, many household and personal activities are carried out at ground level, such as washing up, laundry and bathing (Mulholland, et al, 1998). Squatting, kneeling or sitting positions limit the participation of elderly women with mobility problems in different activities. Sitting on a chair or bench is more comfortable, but embarrassing (Komardjaja and Parker, 2001).

2.3.2 Physical / Architectural Barriers

Architectural barriers, as defined by Alan Farber (Syracuse University) as those physical attributes of buildings and facilities which by their presence, absence or inappropriate design present unsafe conditions and/or deter access and free mobility for the physically challenged in and around buildings and facilities (Bednar, M., 1977).

These barriers refer to the physical domain of the environment, which have been identified, studied and researched at various levels by diverse groups of professionals involved with accessibility research in developed nations. Realization of presence of barriers and the need to remove them is being strongly felt by the developing world whose urban environments are witnessing implementation of strategies to create accessible environments.

Goldsmith (1976) observed that ' the heterogeneity of the disabled population bedevils architectural answers. What may be convenient for one set of disabled people can be anathema to another, and what for the majority is execrable can be indispensable for few.'

Couch, Robert H., (1992)

Architectural barriers have indeed taken their toll on the lives of those who use wheelchairs and those with other mobility impairments (Romano, 1987; Weiss, 1988).

As one group explained, "...architectural barriers are little recognized by the general public, exist on a large scale, and may be eliminated in the private sector only by a voluntary effort..." (Nelson, Jones, & Salkind, 1986, p. 133).

Jones, H E *et al* (2002, 2003) through their DFID project on water supply sanitation access and use by physically disabled people, conducted extensive literature reviews and field studies to gather information related to barriers to access water for sanitation purposes in low income communities of developing countries (like Uganda, Cambodia, Bangladesh).

Barriers to Access Water

For transporting water, distance and terrain can be a barrier (Van der kroft, 2002).
The height and design of pump handles and the design of lifting mechanisms in wells may not accommodate disabled users. Carrying water can be hard for disabled people as appropriately designed or adapted vessels may not exist. Water is commonly stored in traditional storage pots (often large and heavy) which may be placed off the ground for ease of pouring. Other commonly identified barriers to access water are:

Tube Well – Placed at a distance, swampy place, improper height of tube well (in most cases higher than usable), design of pump handle unsuitable for a disabled person, pump handles are tough to press to lift water.

Wells – No suitable mechanism to help disabled people lift water, swampy surroundings

Taps – Placed at a distance, inadequate in number.

Barriers to Toileting

Access needs of disabled people are rarely considered where built latrines are available. Squat toilets are common in Asia and Africa. Sachelo (2002) reported, toilets in the suburbs of Zambia have no sitting pans, which implies that people with impaired lower limbs cannot use them. In the context of Bangladesh, where 85 percent people live in

rural areas, Rahman, S. et al (in Lewis, I, et al , 2002) reported that toilet as a structure is itself a problem. Persons using crutches cannot use toilet properly because there is no handle or support, which they can hold on to while sitting in the toilet. Inadequate space for manoeuvring, which is often not available in public toilets makes it difficult for persons using wheelchairs. High toilet floors make it difficult for a wheelchair user to enter. The current design of toilets does not suit the needs of persons with amputated lower limbs, meaning these people cannot sit in the toilet.

Specific issues have been highlighted about the situation of physically impaired women in the low income groups where one single toilet and bathroom are used by all members of the household. It is reported that the toilet and bathroom are usually poorly maintained, lack a door, lack electricity, lack a container in the facility (toilet and bathroom), lack adequate ventilation and lack washing materials like soap etc. Therefore, use of these facilities by female members is really uncomfortable because they fail to preserve their privacy.

Mulholland et al (1998) reported the issue of carrying water as a barrier when a water source is not close by to the latrine. 'Children with physical disabilities have to cross the dirty environment every day to use the toilets, which are not accessible (Ahsan, 2002).'
Lewis, I et al (2002) reported, 'The squat toilet/latrine is hard for disabled people to use, especially when there are no handles to use for support or to help them stand up. In places where wet toilets/bathrooms are common (eg., Asia) there are specific problems for disabled users – wet and slippery conditions can be dangerous and the required removal/changing of shoes before entering or leaving the wet room can be difficult. Their problems can be compounded, if they have to carry water to the toilet for washing or for flushing, because no water is stored in, or piped to, the toilet.

Barriers to Bathing

Komardjaja, I (in Lewis, I, et al, 2002) a disabled woman from Indonesia reported, 'Instead of squatting, disabled people may sit on a very low seat or on the floor, when washing

clothes or when the walls of the open splash-bathing tank are low.' It is reported, 'Bathing places are often placed at a distance. In the rural areas, the surroundings are generally swampy – they get slippery and there is a risk of falling on such a surface. '

2.3.3 Social Barriers

'Disability [is] a Human Rights issue. So long as people with disabilities are denied the opportunity to participate fully in society, no one can claim that the objectives of the Universal Declaration of Human Rights have been achieved.'

- *Bengt Lindqvist, UN, Special Rapporteur of the Sub-Commission on Prevention of Discrimination and Protection of Minorities.* (World Disability Report, 1999)

Disability does not just affect the individual, but impacts on the whole community. The cost of excluding people with disabilities from taking an active part in community life is high and has to be borne by society, particularly those who take on the burden of care. This exclusion often leads to losses in productivity and human potential (DFID, 2000).

In many developing countries women are assigned a low status, socially, economically and politically. This is accentuated when disability occurs. Girls and women with disabilities are left marginalized, neglected and are often considered a burden. Social exclusion is often the hardest barrier to overcome, and is usually associated with feelings of shame, fear and rejection. Negative stereotypes are commonly attached to disability. People with disabilities are often assigned a low social status and in some cases are considered worthless.

While referring to the sustainability of the Universal design concept, Sandhu, J.S. *et al* (2001) raised a concern that though physical distances between nations have died due to globalization, attitudinal distances remain, however, and they are a major stumbling block. Balram, S.(2001) refers to the weakness of the social construct in the developing

countries, which severely inhibits the equal participation of certain sections of society in public and private life. He notes that this weakness is merely physical or sensory in the industrialized and relatively wealthy countries.

He notes about the caste system prevalent throughout Indian society, though more apparent in villages. Access is denied for certain communities of people to several important places such as worship, festivals, public functions, and even common water sources. Regardless of their physical impairment, these groups of people are excluded.
He strengthens his ideas by saying, that the first major task facing the designers is to promote public opinion towards a positive universal attitude.

'In Bangladesh, because many community members believe that impairments are contagious or a punishment, disabled people may for example be prevented from sharing latrine facilities, which forces families to use unhygienic sanitation practices.' (CRP, 2002). Komardjaja (2001) reported, 'Social barriers are often less easy to identify than physical barriers, and therefore less easy to change.' Family attitudes compounded by negative community attitudes, stigmatize living for persons with disabilities.

It was found, that the negative attitudes of other community members towards disabled people, hinders their access to and use of water and sanitation facilities. Not only other people are ignorant about their needs, but they may even ridicule or abuse disabled users.

2.3.4 Institutional Barriers

While referring to the misunderstandings about the terminologies of universal design and accessible design, Welch and Jones (1999) note, "This indicates that significant systemic and attitudinal barriers stand in the way of real change."

Dejong, Lifchez (1983) argues on the issue of considering cost benefit as the sole criteria for removing barriers or implementing universal design. The governments in the majority-world countries are preoccupied with the basic issues facing people, such as poverty alleviation, literacy, better infrastructure, roads, drinking water, sanitation, and so on. Most of these efforts concern average people, and there is hardly any time and resources left for the needs of the people who are elderly, disabled, and other people who are not average and who are presently a voiceless minority in comparison. Besides, people prefer family care to state care. There are further problems that hinder the process of the few welfare measures taken by these governments. Due to the economic backwardness, corruptive practices are rampant; whatever state allocations are made for the social welfare programs do not reach the deserving people.

"Historically, nobody has been responsible for ensuring that people can get to key services and employment sites. As a result, services have developed with insufficient attention to accessibility. In addition, too often access to services has been seen as merely a transport issue rather than one that can be solved by, for example, better land-use planning, or through policies to enable safer streets and stations" (Social Exclusion Unit, 2003, p. 40 in Farrington, J. *et al,* 2005).

Lack of disability focused services

Jones, H.E., *et al* (2003) reported, There is a lack of awareness and understanding about disability among the majority of service providers, which is compounded by an absence of appropriate and available information that would enable them to take practical steps to improve access for disabled people.

Ineffective Services

Top- down approaches and methods are introduced without regard to local culture, and with a lack of consultation with disabled consumers and their families (Kalyanpur, 1996)

Lack of Affordability

The cost of assistive devices is prohibitive for most. Taunyane and Hiroschowitz (1995) found that more than half the African disabled respondents in the study did not have the appliances they needed, because of poverty.

Lack of Information

At community level, families typically lack information and knowledge to meet the care and rehabilitation needs of their disabled members. Literacy rates in any case are very poor among disabled people and in rural communities, and written and print media have little effect on the majority of people (Balram, 2001). In Bangladesh, no printed information is available on access to water and sanitation facilities (CRP, 2002).

Payne (2002) noted, individuals and families over ages have improvised their own situations, but the benefit of their ingenuity is often not passed on to others, because it is not documented or shared verbally.

Lack of Participation by PWDs , consumer involvement and lack of training, support and follow up by service providers are other reasons pointed for ineffective services (Jones, H, et al , 2002).

Lack of access to mainstream services / programmes

Jones, H et al (2002) report, lack of information about low cost solutions perpetuates the perception that accessibility is costly. Design professionals are largely unaware of the impact of barriers in the environment on older or disabled people and how these may be removed, often by simple planning at both strategic and detail level (Parker, 2001).

2.4 THE CONTEXT OF RURAL ENVIRONMENT

The majority of people in the Asian and Pacific region live in rural areas. In the coming decade, not withstanding rapid urbanization, there will be a higher increase in absolute numbers of rural population. Higher rates of mortality and morbidity, a lower rate of

literacy and a higher incidence of poverty deprivation characterize rural communities, placing them in a less advantageous position than their urban counterparts.

Furthermore, while several basic amenities such as piped water supply, sanitation, toilets and access to the mass media are available to urban residents at the household level, in rural areas, these are often available only as community amenities. These facilities have an impact on daily lives of people in rural areas. The extent to which the facilities are accessible and usable by persons with disabilities and elderly people determines their integration into rural community.

Werner (1998, 82) is the most widely referred publication on disabled village children. It comprises of a detailed account of designs and adaptations in the rural environments. It refers to rehabilitative, therapeutic interventions with children with disabilities at an affordable level of the rural context. It refers to most cases of developing nations like Mexico, India, Africa. The literature available in his books are aimed at disability focused practitioners and not specifically for the Activities of Daily Living performed by the rural people.

Balaram, S. (2001) noted that in the economically sharply divided world of haves and have-nots, the situation in the world of have-nots often goes unnoticed. He strongly pointed out, 'But the world cannot go forward with a major part of its body missing.'

2.4.1 Activities of Daily Living

Nichols, PJR (1976) noted, that the activities of daily living can be reduced to four basic activities one has to consider: sleeping, eating, personal toilet and mobility. Mobility is introduced because it is preferable that the three basic activities should be done in different places. Mobility is the key to daily living for the physically disabled.

He further reports in the context of Great Britain, 'Housework is a complex activity and occupational therapists spend a lot of time assessing and aiding the disabled housewife to

overcome her problems. Aids, appliances and architectural alteration to the kitchen all play their part in enabling the disabled housewife to continue to act as the home maker.' Personal toilet involves large number of activities demanding considerable manual dexterity. Rimmer, et al (2002) identified the barriers and facilitators to the Activities of Daily Living in the European context.

Jackson, C.M. (2000) estimates that approximately 60 million disabled people in developing countries need help in performing basic water and sanitation tasks. If these people are able to perform more of these ADLs they will lead cleaner, healthier and more independent lives. He further suggests that this would also remove the burden of personal care from other family members and help with social integration, restore dignity to the individual and would be of particular benefit to those living in extreme poverty.

Special aids have been developed for disabled people in industrialized societies but many of these are totally unsuitable for conditions in developing countries. Cultural considerations are also important, for example, if it is customary for people to sit on the ground a disabled person will not like to be raised up in a wheelchair. Simple, locally-made aids have many advantages. They are easy to make, cheap to replace and can be made to suit the individual's requirements and adapted to his or her changing needs.

Helander (1992) stressed the importance of ADLs; 'When people in developing countries mention needs in connection with functional difficulties, the most oft-cited concern is the burden to the family – physically, psychologically and economically. Dressing and feeding a disabled person and attending to his/her personal hygiene are time-consuming tasks.'

Mulholland, S J et. al (2000) found, while evaluating the mobility device for Indian women that women with disabilities in India have few options when they are in need of a wheeled mobility device to replace their ability to walk. They enlisted three principal reasons that presented a mobility challenge to their traditional lifestyle.

1. "Firstly, women in India typically perform activities of daily living (self-care, work, leisure) both inside and outside the house. Physical barriers such as slopes, mud, rocks and steps are commonly encountered and the women often exposed to the elements. Wheelchairs were designed to travel indoors and outdoors over relatively smooth surfaces and often do not cope well with rough terrain.
2. Secondly, most activities are performed on or close to the ground, the floor being used as a work surface. For example, pots and clothes are washed whilst squatting on the ground and cooking is frequently done on a chulha (wood, dung burning stove commonly at ground height). Both the wheelchair and the tricycle position the rider at table height which means that dismounting would be necessary to perform ground height activities.
3. Thirdly, activities are commonly performed in locations within or in close proximity to the home. The tricycle was designed to travel relatively long distances and hence is too cumbersome to be maneuvered within the home.

2.4.2 Issues of Appropriateness

Balram, S.(2001) reports in the context of socio cultural prominence in developing nations , " Although, the joint family system is on the decline due to urbanization, it is still largely present in the villages, which constitute 80 percent of India. There is also a very important micro level, traditional self governing system in villages that continues even today. This is called the Panchayati system. It is a local governance where it becomes the prerogative of the elders of the community to participate and lead the lifestyle of the people.

Jones, H et al, 2001 has extensively reviewed the issues of appropriateness as follows.

Cost and Affordability – A major barrier for the majority. In poorer areas where family members are always on hand, local practice maintains that it is more viable for a person to be carried about than to invest in Assistive devices. Situations such as these must only

improve over time, as accessibility is demonstrated to be achievable by the simplest of the means, at minimal cost or effort (Harrison and Parker, 2000).

Locally available resources and materials

Many a solution has been found to be inappropriate, as it did not fulfill the necessary criteria of cultural appropriateness, home context and sustaining the user's dignity (Thorburn et al, 1990a; Van Brakel and Anderson, 1998).

Cultural Acceptability

This is a combination of aesthetics, image and personal dignity. ' Appropriate assistive technology doesn't have to mean cardboard seats and tire tread sandals' (Enders, 1998). Many a solution has been found to be inappropriate, as it did not fulfil the necessary criteria of cultural appropriateness, home context and sustaining user's dignity (Thorburn et al, 1990a; Van Berkel and Anderson, 1998).

Local Beliefs and Attitudes

'Cross cultural biases (urban-rural) and unquestioned assumptions are only compounded by ethnic and socio economic differences' (Enders, 1998).

Gender appropriateness

In a study in India, women with lower extremity disabilities were reported to clearly identify activities they wished to perform if they could move more easily, a clear example of improved independence and quality of life through improved mobility through the application of effective assistive devices (Mulholland et al, 1998)

2.4.3 Aids and Adaptations

The researcher believes that rural people have to innovate out of sheer necessity being addressed as an urgent need. Personal limitations along with the social living context, forms the guiding principle for their developments of aids & adaptations to improve

functioning in the performance of Activities of Daily Living. Their innovations, however may have a scope of further refinement through a design process which could make it more universalized and far reaching in its implication. Jones, H E, et al (2003) conducted in depth field studies in developing countries of Cambodia, Uganda and Bangladesh through a DFID project on water supply and sanitation access and use by physically disabled people. Fig.2.10 to Fig.2.18 show the various aids and adaptations for toileting and bathing spaces in low income rural communities of developing countries.

Figure 2.10. Child with a weak leg holds a rope for support in a communal latrine in a Dhaka slum (CSID project)
Source : Jones, H, et al (2002)

Figure 2.11. Bamboo support poles in a rural latrine in Gobindapur (CRP community project)
Source : Jones, H, et al,(2002)

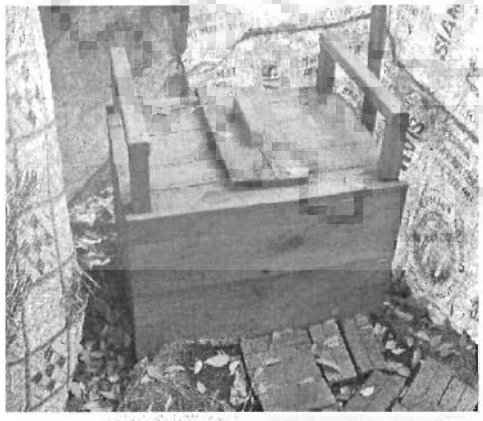


Figure 2.12. Wooden toilet seat installed over latrine pit (SCI Centre, Battambang).
Source: Jones, H E, et al (2003)

Fig. 2.13: CRP wheelchair with small tyre inner tube in place of the seat cushion for purposes of bathing or toileting.
Source : Jones, H E, et al (2003)

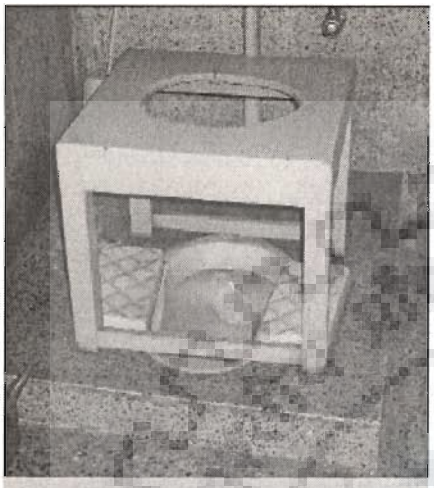


Fig. 2.14 Wooden toilet seat placed over squat toilet

Fig. 2.15 Commode chair with home adaptations

Fig. 2.16 Low concrete sitting platform to access hand pump
Source : Jones, H E, et al (2002)

Fig. 2.17 Rounded Threshold for bathing space, surmountable by wheelchair

CENTRAL LIBRARY
ACC.No G14265
Date
I.I.T. ROORKEE

While laying stress on the need for universal design in developing nations like India, Balaram (2001) also refers to a case study of a foldable toilet seat attachment developed by a senior design student of National Institute of Design, India. The foldable seat thus developed can cater to the middle income group families in the Indian context. This new device made of polypropylene and with good mechanical strength has integrated in its design, grab bars for a person with mobility impairments to comfortably sit and get up from the chair. However, it may require further modifications to lower down its cost for making it affordable to the people in the rural communities.

2.5 DESIGN THEORIES AND ACCESSIBILITY RESEARCH

Jones, H E, et al (2003) concluded as their findings, 'Good design is good for people, including disabled people. There is a mistaken perception that disabled people all need separate 'special' facilities. For the majority of disabled people this is not the case.'

Luck, R. (2003) reported, 'Participatory design approaches are considered to reflect design as a social process, illustrating that the sphere of the design activity extends beyond the designer. The egalitarian, non discriminatory principles of participatory design are common with an 'inclusive' approach for the design of environments, which should not discriminate on accessibility.'

Mitchell, J. (1976) explained the idea of reducing need by design to introduce low handicap technology. He stated, 'If a responsibility cannot be met by an individual then a need remains unsatisfied and requires intervention to avert consequences. I would like to turn to the factors which lead to need being unsatisfied – to do this he explained the term Handicap. " Handicap is the unsuccessful interaction between the users and their environments." He illustrated this through Bauer's formula (Fig. 2.18) :

Handicap = Environmental Demands / Population Abilities

Fig.2.18 Understanding Handicap

He noted, ' If a great number of people in a population are unable to meet their needs without extensive special provisions then there is something radically wrong with their environments.' He concluded by saying that a low handicap environment can allow the population to meet its needs without special intervention, and since our ability to provide special intervention is low, the time is now right for learning to build our equipment and environments to suit all who must use them.

2.5.1 Design Approaches

Wijk, M. (2001) reviewed the development of design approaches for accessibility in the Dutch context. He illustrated through simple figures, as in how accessibility got trapped in each of these approaches. Referring to Fig. 2.19, he explained the *Traditional Implicit Design Approach* as the most widely practiced design approach. The circle represents the total sum of human needs, and the square represents a design which is implicitly based on a uniform presumption of human abilities. The gap is the space between the circle and the square.

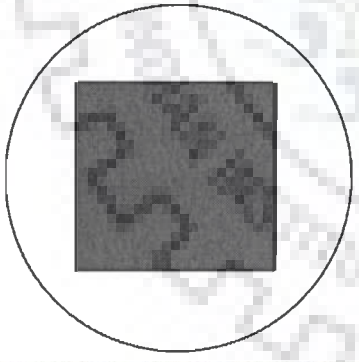


Fig. 2.19 Traditional Implicit Design Approach

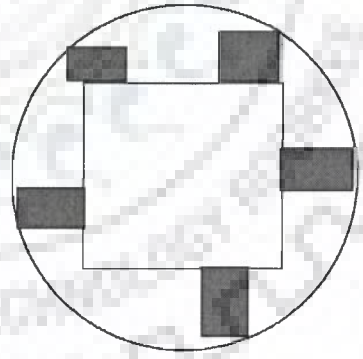


Fig. 2.20 Designing for the Disabled

Another approach aimed at improving the accessibility for the people with disabilities led to filling of gaps between the representative circle and square (Fig. 2.20). Labeled as *Designing for the Disabled*, when the relation between disability and accessibility became

a rehabilitation issue, the term *accessibility* got stuck in its gap. The rationale of filling gaps for the people with special needs through design fails to reach the average human as it became a stigma and an addition to the normal human needs.

Fig. 2.20 shows that focusing on the specific needs of categories (squares) beyond the implicitly presumed uniform needs, hardly covers the total sum of human needs (circle), and is rather stigmatizing and isolating the issue.

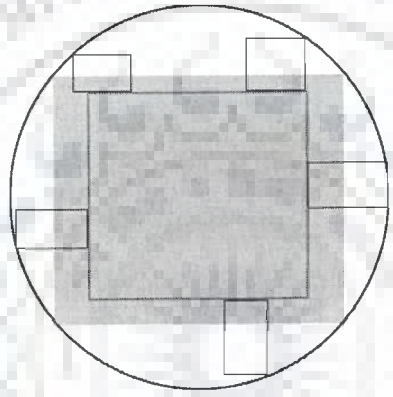


Fig. 2.21. Integral Design Approach

Wijk stated, ' The ordinary – and universal –truth is that people differ in every single aspect of their abilities. People differ in the way they perceive their environment, the way they understand it, they way they act in it, and the way they are just in it.' This called for a design approach that could integrate the special needs of the persons with disabilities into the normal needs of an average man. Labeling it as an Integral design approach (Fig. 2.21) the gap still remained, which was quite logical: A square would never cover a circle, thereby excluding the severely disabled from the integral average needs.

Series of developments over decades in the context of understanding accessibility issues and addressing them with appropriate design approach has been a continuous process. Though, the above case reflects a Dutch experience, it does point at the criticality of the

design approach as an interpretation of different terms which ultimately guide the national policy.

2.5.2 Barrier Free Design

Bednar, M.J. (1977), while introducing the concept of barriers defined *barrier free* as "An environmental design that is responsive to life's stages and the capabilities of all users." Jeffers, J. (1977) further redefines barrier –free design to mean, '...the incorporation and utilization of design principles that result in the construction and creation of functional, safe, and convenient environments responsive to user needs."

It refers to the efforts that began in the late 1950s to remove barriers for disabled people from the built environment. In United States, *accessible design* became more widely used in the 1970s as a more positive term than barrier free design. However, in Europe, the term *design for all* has been increasingly used since 1967, and now the more popular term in Japan is *universal design*.

In his paper on creating a responsive environment, Steinfeld, et al (1977) notes, ' The built environment communicates in a silent language to those who use it and it transmits messages about appropriate behavior and meanings.' He concluded by anticipating a shift in approach from blaming the disabled person to blaming the environment in which disabled people can display competence and are able to overcome dependency and stigma that stems from being environmentally incompetent.
An environmental design that is responsive to life's stages and the capabilities of all users can truly be termed *barrier free* (Bednar, M J, 1977).

2.5.3 Universal Design Approach

Universal design is a term that was first used in the United States by Ron Mace (1985). He defined Universal design as an approach to design that incorporates products as well as building features which, to the greatest extent possible, can be used by everyone. He

noted that minimum standards are an important part, but not the definition of universal design.

Universal design has often been used interchangeably in the United States to label a design approach that implies equity and social justice by design. Although, there are other terms that are frequently used, such as *life span design* and *transgenerational design*, Mullick and Steinfeld (1997) explain that what separates universal design from these terms is universal design's focus on social inclusion. This relates to " Separate is not equal" precedent of equal opportunity.

Universal design is not a trend but an enduring design approach that assumes that the range of human ability is ordinary, not special (Ostroff, E., 2001). She refers to the change in design approach for people with functional limitations in the past 15 years from narrow code compliance to meet the specialized needs of a few to a more inclusive design process for everybody. She reports that Universal design is assuming growing importance as a new paradigm that aims at a holistic and integrated approach to design, ranging in scale from product design to architecture, and urban design on one hand, and systems controlling the ambient environment and information technology, on the other. It is supported by the following seven design principles (Table 2.2)

Table 2.2 The key principles of universal design

Principle	Description
Simple and Intuitive use	The use of design is easy to understand regardless of the user's experience, knowledge, language skills or concentration levels.
Equitable use	The design does not disadvantage or stigmatize any group of users.
Perceptible Information	The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities.
Tolerance for Error	The design minimizes hazards and the adverse consequences of accidental or unintended fatigue.

Flexibility in use	The design accommodates a wide range of individual preferences and abilities.
Low physical effort	The design can be used efficiently and comfortably and with a minimum of fatigue.
Size and space for approach and use	Appropriate size and space is provided for approach, reach, manipulation and use, regardless of the user's body size, posture or mobility.

(Source: Centre for Universal Design, 1995)

Sandhu, J. S. *et al* (2001) defined Universal design as a concept that extends beyond the issues of compliance with accessibility standards for people with disabilities and offers a powerful rationale for responding to the broad diversity of users who have to interact with the built environment. He further adds, Fundamentally, it is an approach that values and celebrates human diversity and it highlights a major paradigm shift – from treating people as part of the medical model, as dependent, passive recipients of care and services, to a model in which everyone is treated as an equal citizen and disability is seen merely as a social construct. He reinstates that greater attention needs to be paid on sustainability and the quality of natural environments.

Goldsmith, S. (2001) demonstrates the bottom – up methodology of universal design through the universal design pyramid (Fig.2.22) from a British perspective. Diverse profiles of persons are arranged from bottom (row 1) to top (row 8) in the decreasing hierarchy of their degree of mobility. Rows 1 and 2 have people who are fit and agile while row 5 has ambulant people with disabilities. Row 6 has people with self driven wheelchairs, row 7 comprising people with electric scooters and in row 8 are wheelchair users with assistants.

Universal design can be obtained only by working from the bottom up, by looking to make normal provisions suitable for everyone. It aims to be socially inclusive and is compromised if 'accessibility' is defined in terms of provision for people with disabilities only.

device, while non ambulant disabled are those who have a complete loss of mobility and are thus either chair bound or require complete assistance to be lifted or crawl for mobility needs. This classification is important from the perspective of understanding their limitations in the performance of Activities of Daily Living.

2.2.3.1 International Perspective

Goldsmith, S (1976) notes, among people with medical disabilities it is those with a locomotor disability – ambulant disabled people and wheelchair users – who are most vulnerable to disablement when using public buildings and whom the architect, as enabler, can most effectively help.

Lavery, I. *et al*(1996) reviewed the status of mobility impaired in Europe and found that atleast 10% of any population has some degree of mobility problems which makes it difficult, if not impossible, for them to use conventional public transport. This 10% should be considered to be a minimum figure e.g. the figure for disability in Great Britain is 14.2% but in Wales and Northern Ireland the figures are 17.0% and 17.5%, respectively. He further reported, mobility-impaired people have a wide variety of functional impairments and it should be noted that only 2-3% of disabled people are in wheelchairs. Many people with mobility problems do not wish to be classed under de-personalizing terms as 'disabled' or 'handicapped' and sometimes they are reluctant to disclose that they have mobility problems.

Enviro- FIM™

Derived from the FIM™, Enviro FIM™ is a 11 point observer rating scale to evaluate design artifacts in terms of their impact on the functional independence of an individual or a group. It also enables a global assessment of fit between subjects and designed physical environments through determining the mismatch between environment's demand character and a subject's mastery level. However, it requires a trained observer for its administration.

Functional Performance Measure

The Functional Performance Measure (FPM™) employs two observer rating scales to score the *level of effort* expended by the subject towards task performance and the *level of assistance provided* by a caregiver. While Enviro FIM™ instrument implies a continuum between degree of independence and assistance, FPM™ scale separates the measurement of individual performance from assistance. It highlights the concept that caregiver burden may vary independently from the effort of the individual receiving care. FPM™ could thus be used to identify the needed design changes in specific task environments that will improve the subsequent task performance. It also requires a trained observer for its administration and videotaped records are needed to do the detailed analysis required.

The Enabler

Jensen, G., *et al* (2001) reported that there is a shortage of valid and reliable methods in order to assess accessibility, i.e. the relationship between functional capacity and environmental demands. They then refer to the Enabler Concept, which was developed with a notion that accessibility is a relative construct and remains a starting point for the development of methods for accessibility assessments. They further note that while planning an accessible environments or making a general assessment of how accessible a

rural areas, Rahman, S. et al (in Lewis, I, et al , 2002) reported that toilet as a structure is itself a problem. Persons using crutches cannot use toilet properly because there is no handle or support, which they can hold on to while sitting in the toilet. Inadequate space for manoeuvring, which is often not available in public toilets makes it difficult for persons using wheelchairs. High toilet floors make it difficult for a wheelchair user to enter. The current design of toilets does not suit the needs of persons with amputated lower limbs, meaning these people cannot sit in the toilet.

Specific issues have been highlighted about the situation of physically impaired women in the low income groups where one single toilet and bathroom are used by all members of the household. It is reported that the toilet and bathroom are usually poorly maintained, lack a door, lack electricity, lack a container in the facility (toilet and bathroom), lack adequate ventilation and lack washing materials like soap etc. Therefore, use of these facilities by female members is really uncomfortable because they fail to preserve their privacy.

Mulholland et al (1998) reported the issue of carrying water as a barrier when a water source is not close by to the latrine. 'Children with physical disabilities have to cross the dirty environment every day to use the toilets, which are not accessible (Ahsan, 2002).'
Lewis, I et al (2002) reported, 'The squat toilet/latrine is hard for disabled people to use, especially when there are no handles to use for support or to help them stand up. In places where wet toilets/bathrooms are common (eg., Asia) there are specific problems for disabled users – wet and slippery conditions can be dangerous and the required removal/changing of shoes before entering or leaving the wet room can be difficult. Their problems can be compounded, if they have to carry water to the toilet for washing or for flushing, because no water is stored in, or piped to, the toilet.

Barriers to Bathing

Komardjaja, I (in Lewis, I, et al, 2002) a disabled woman from Indonesia reported, 'Instead of squatting, disabled people may sit on a very low seat or on the floor, when washing

improve over time, as accessibility is demonstrated to be achievable by the simplest of the means, at minimal cost or effort (Harrison and Parker, 2000).

Locally available resources and materials

Many a solution has been found to be inappropriate, as it did not fulfill the necessary criteria of cultural appropriateness, home context and sustaining the user's dignity (Thorburn et al, 1990a; Van Brakel and Anderson, 1998).

Cultural Acceptability

This is a combination of aesthetics, image and personal dignity. ' Appropriate assistive technology doesn't have to mean cardboard seats and tire tread sandals' (Enders, 1998). Many a solution has been found to be inappropriate, as it did not fulfil the necessary criteria of cultural appropriateness, home context and sustaining user's dignity (Thorburn et al, 1990a; Van Berkel and Anderson, 1998).

Local Beliefs and Attitudes

'Cross cultural biases (urban-rural) and unquestioned assumptions are only compounded by ethnic and socio economic differences' (Enders, 1998).

Gender appropriateness

In a study in India, women with lower extremity disabilities were reported to clearly identify activities they wished to perform if they could move more easily, a clear example of improved independence and quality of life through improved mobility through the application of effective assistive devices (Mulholland et al, 1998)

2.4.3 Aids and Adaptations

The researcher believes that rural people have to innovate out of sheer necessity being addressed as an urgent need. Personal limitations along with the social living context, forms the guiding principle for their developments of aids & adaptations to improve

Flexibility in use	The design accommodates a wide range of individual preferences and abilities.
Low physical effort	The design can be used efficiently and comfortably and with a minimum of fatigue.
Size and space for approach and use	Appropriate size and space is provided for approach, reach, manipulation and use, regardless of the user's body size, posture or mobility.

(Source: Centre for Universal Design, 1995)

Sandhu, J. S. *et al* (2001) defined Universal design as a concept that extends beyond the issues of compliance with accessibility standards for people with disabilities and offers a powerful rationale for responding to the broad diversity of users who have to interact with the built environment. He further adds, Fundamentally, it is an approach that values and celebrates human diversity and it highlights a major paradigm shift – from treating people as part of the medical model, as dependent, passive recipients of care and services, to a model in which everyone is treated as an equal citizen and disability is seen merely as a social construct. He reinstates that greater attention needs to be paid on sustainability and the quality of natural environments.

Goldsmith, S. (2001) demonstrates the bottom – up methodology of universal design through the universal design pyramid (Fig.2.22) from a British perspective. Diverse profiles of persons are arranged from bottom (row 1) to top (row 8) in the decreasing hierarchy of their degree of mobility. Rows 1 and 2 have people who are fit and agile while row 5 has ambulant people with disabilities. Row 6 has people with self driven wheelchairs, row 7 comprising people with electric scooters and in row 8 are wheelchair users with assistants.

Universal design can be obtained only by working from the bottom up, by looking to make normal provisions suitable for everyone. It aims to be socially inclusive and is compromised if 'accessibility' is defined in terms of provision for people with disabilities only.

Balaram, S. (2001) stated that design is an activity that is based on socioeconomic criteria and that will, therefore, naturally follow suit in being different in the countries. He further explained, 'It is too simplistic to treat design as an isolated aesthetic activity existing outside the mainstream forces of economics, culture, and society. Design in the economically developing world is beyond an activity that is concerned with formal qualities and superficial aspects aimed at boosting sales. It is a serious activity that is concerned with playing a key role in economic and social development of the people. Moreover, centuries old traditions are bound to have a profound influence on people's behavior and pattern of choice, which go beyond physical rationale.'

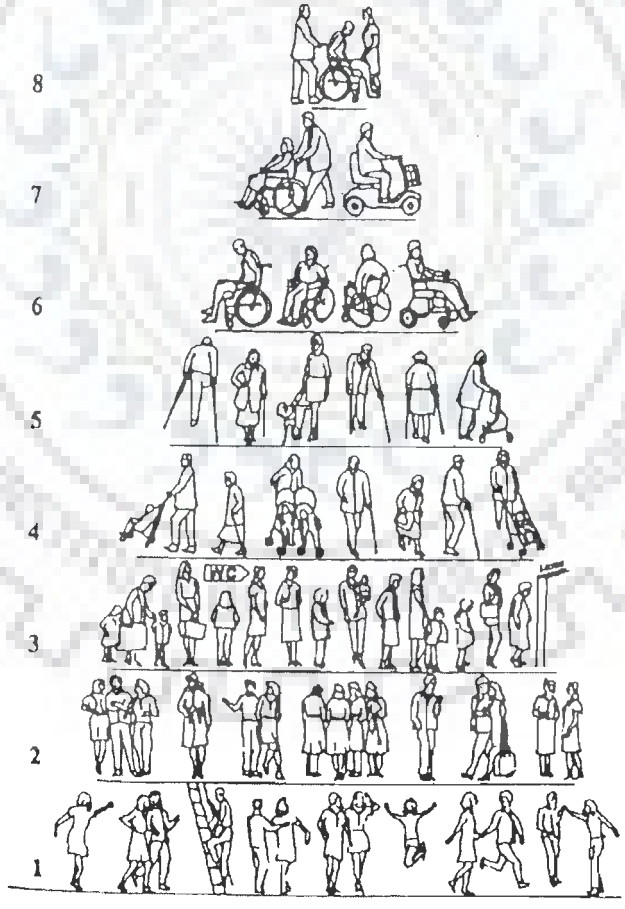


Fig. 2.22 Bottom-up methodology of Universal Design
Source: Goldsmith. S, (2001)

To explain, how the economic, social and cultural realities of non industrialized countries affect universal design, he enlists three possible ways:

1. The prevalence of oppressing realities such as poverty, population pressures, illiteracy, and lack of infrastructures calls for universal design solutions vastly different from those elsewhere.
2. These realities also make implementation of universal design extremely difficult.
3. Since success breeds success and vice versa, the very weaknesses mentioned earlier will create more problems of the disability, old age, and the like, due to malnutrition, inadequate prenatal and postnatal care, inadequate sanitation and hygiene, ignorance of child medication, unsafe and accident prone situations due to bad road conditions, and poor industrial environments.

He, thus suggests the need to view universal design from a different perspective as from the perspective of industrialized (developed) nations. Defining Universal design in the context of majority world (the industrializing/developing nations), he defines it as a concept that extends not only beyond issues of accessibility of the built environment, but that also covers the social, cultural, and economic issues, which are major influences in uniting normal or average people and people with different physical, mental, or psychological abilities. He remarks, " If one accepts universal design as an approach that values and celebrates human diversity, majority world countries such as India and China have overwhelming and perhaps unmanageable cases. For instance, India's cultural, religious, linguistic, and ethnic diversities are almost impossible to comprehend.

Connell, B R *et al* (1996) in their paper on evaluation and validation of universal design principles highlighted the issues in the way as stated below, " It must be acknowledged that the principles of universal design in no way comprise all criteria for good design, only universally usable design. Certainly, other factors are important, such as aesthetics, cost, safety, gender and cultural appropriateness, and these aspects should

be taken into consideration as well when designing. Whenever possible, however, attempting to broaden the market beyond strictly people with disabilities or those who are older will increase the size of the market. It can reduce the cost of the product, and reduce the segregation and stigma that may be associated with it. The universal design principles and related guidelines can provide an important starting point but by no means a complete solution to creating a more universally usable world. Adherence to these principles does not replace the need to involve consumers in the design process to the greatest extent possible. By the same token, encouraging designers to embrace a more empathic approach and view their work from the perspective of the full range of prospective users is an important step in the right direction."

Universal Design requires that an inclusive and pluralistic model be adopted in which design for differences is a key strategy (Steinfeld, 1996). Universal Design is not yet a coherent approach to designing for people. It has many missing pieces in its complex jigsaw puzzle (Sandhu, 2000). Parker, (2001) asserted to regularly update the definition of Universal design to stay relevant to the present and futuristic needs of the people.

Inclusive design stems from an appreciation of 'diversity' and 'advocacy', it recognizes the need to 'design for all' and make change as and when necessary. It is a fresh paradigm which is more appropriate, relevant and effective in creation of built environments and is a reflection of more caring and equitable societies (Parker, K.J., 2001). Parker concluded that, "Universal design is a utopian ideal, but thinking inclusively is the catalyst for getting closer to a user friendly world for everyone. "He further states, that Universal design must keep updating its definitions, principles and intentions in order to stay relevant to the present and future needs of the societies.

2.6 REHABILITATION APPROACHES

Until relatively recently disabled people were perceived as incapable of making their own decisions and of taking control of their lives; they were viewed as people who always

needed to be helped or as objects of pity and charity (Coleridge, 1993). In many parts of the Third World attitudes and practices towards disabled persons also reflect the superstitions and beliefs which may be a hangover from earlier cultures (Thorburn & Marfo, 1990). Assisting people with disabilities could help them to lead productive, satisfying lives, providing a society that is accessible for all, not only in the physical but also in the social environment (WHO, 1999).

A comparison between the rehabilitation model and the independent living model illustrates their central differences. In the rehabilitation paradigm, problems are generally defined in terms of inadequate performance in the physical activities of daily living or in terms of inadequate preparation for gainful employment. In both instances and central to the rehabilitation model, the problem is assumed to reside in the individual. It is the individual who needs to be changed. To overcome his/her problem the disabled individual is expected to yield to the advice and instruction of a physician, physiotherapist, occupational therapist or vocational officer. The disabled individual is expected to assume the role of the 'patient' where success is based on whether or not the patient complied with the prescribed therapeutic regime. Unlike the rehabilitation model, the independent living paradigm sees the problem of disability located in the physical, architectural and attitudinal environments. Therefore the solution to the problem is not in changing the individual but the environments in which the person with the disability lives (McGettrick, G., 1994)

DeJong (1979 : 444) summaries the main differences between the two models which in turn illustrates the essential relevance of the independent living paradigm to this research;

"As a paradigm of research, independent living offers us an opportunity to steer away from the myopic pre-occupation with unalterable individual characteristics that direct our attention from the larger institutional and environmental context in which disabled people

live.The institutional and environmental context have for too long been accepted and given."

2.6.1 Institution Based Rehabilitation

In this system of rehabilitation, a disabled person comes to the institute and receives training from the professional personnel there. This is the prevailing system in the developing countries. Patients coming from far off places are detached from their community and environment and face problems of transportation. The institution based delivery system is inappropriate when it comes to providing services to a very large number of disabled persons. It is commonly observed that most disabled persons in developing countries come from poor families with little education and are unlilkely to take initiative to avail these services. Further, the costs and requirements of professional personnel are constraints.

2.6.2 Outreach Programmes & Community Based Rehabilitation

It is a time consuming and a labour intensive programme. The number of disabled people who can be supported in this way is limited by the number of outreach workers available.

Community-Based Rehabilitation (CBR) involves measures taken at the community level to use and build on the resources of a community, including impaired, disabled and handicapped people themselves, their families and their whole community. The concept of CBR has been formally promoted by WHO since 1976 and put into practice in several developing countries since that time. According to Helander (1984) it has three fundamental features: (1) its focus on community involvement, (2) its use of simplified rehabilitation technology, (3) its service delivery system.

Clearly though the interventions of community rehabilitation workers (CRWs) have enabled people to participate in many of the tasks of daily living (Dolan et al., 1995).

Mulholland et al (1998) suggest that, in the provision of assistive technology, independence may be a less important consideration than quality of life. Examples of relevant aims could include reducing unhappiness, preventing clothes getting dirty, and the ability to carry out one's role in the family.

2.7 ASSISTIVE TECHNOLOGY

Assistive technology is defined as, 'any item, piece of equipment or product system whether acquired commercially off the shelf, modified, or customized that is used to increase or improve functional capabilities of individual's with disabilities' (American Technology, 1988). He further stated, 'The development of appropriate technology, in particular appropriate assistive technology, is a complex and iterative process which must address all design parameters. The design team must find the optimum balance between the individual's needs, therapeutic and or medical concerns (e.g. positioning, pressure relief) and technical and engineering constraints (e.g. durability of materials Vs weight and cost). Orpwood, R D (1990) advocates a client centered approach whereby the intended consumers participate in the design process.

The basic goal of a prothestic device is to provide a disabled person an aid that can perform the function of one or more limbs. The earliest assistive devices were prosthetic limbs, dating back to 500 B. C. while the early wheelchairs, in contrast, found widespread use less than 300 years ago (Muhlenberg, A.N. *et al*, 1988).

2.7.1 Assistive Devices

Artificial Limbs Manufacturing Corporation (ALIMCO) is the single largest manufacturer of assistive devices in India, supported by the Government of India. projected the need for assistive devices in India (Table 2.3). Saha, R. et al (1995) reported that there are only a few assistive-device manufacturers in the organized sector in India whose total production capacity may meet only 5 to 7 per cent of the requirements. No data on

manufacturers in informal sector production centres is available, but these centres are probably fulfilling only 2-3 per cent of the requirements of people with disabilities.

Table 2.3 Need for Assistive Devices in India

Type of device	Estimated number required (million)
Prostheses	0.8
Orthoses	3.6
Braces	0.8
Wheelchairs and tricycles	1.4
Crutches and walking sticks	1.4
Devices for people with visual impairments	3.6
Devices for people with hearing impairments	2.9

For the distribution, Eleven District Rehabilitation Centres provide assistive devices in the rural areas of specified regions. Devices are also distributed through camps, organized by NGOs and governments. ALIMCO alone organized 92 camps in the year 1993-94. He reported, 'Though, an income certificate is necessary to receive devices at a concessional rate under the District Rehabilitation Centre scheme, an income certificate is not required as the devices are given free of cost to rural people with disabilities.'

All components for orthoses and prostheses are produced indegneously. Wheelchairs and tricycles use only materials available locally. This results largely from India's massive bicycle industry, which has led to the easy availability of wheels, bicycle chains, tyres and other components. Production is very convenient as mild steel is extensively used, but its use makes these devices very heavy. In addition, the wheelchairs and tricycles are of much larger size than an average Indian. Smaller devices are likely to be cheaper as well

as more appropriate. The type of materials used to produce various assistive devices is mentioned below (Table 2.4).

Table 2.4 Materials used for assistive devices

Types of device	Material used
Prostheses	Wood , plastic , fabric, rubber, fiber , glass , leather, aluminium, steel
Orthoses	Leather , fabric , plastic , aluminium , steel
Braces	Leather , fabric , plastic , aluminium , steel
Wheelchairs	Steel , rubber , plastic
Tricycles	Steel , rubber , plastic
Crutches	Wood , fabric , rubber , aluminium
White canes	Aluminium , rubber , plastic

Approximate prices of the assistive devices are also mentioned hereby (Table 2.5):

Table 2.5 Approximate prices of Assistive devices in India

Type of Device	Unit cost (US$)
Prostheses upper	15.0 – 75.0
Prostheses upper	40.0 – 125.0
Crutches (per pair)	18.0
Wheel chair and tricycles	100.0 – 175.0

Mulholland et al (2003) suggests development of appropriate technology to meet the needs of persons with disabilities in low income communities. Appropriate technology, is defined as one which best suites the individual's cultural, functional, geographical, safety and financial needs using locally available materials and human resource. This term is often used in conjunction with assistive technology i.e. appropriate assistive technology (Sethi, P.K., 1989, Stone, J.H., 1993). The World Health Organization supports the development of appropriate technology within the context of assistive technology (WHO, 1979).

Mullholland, S.J. *et al* (2003), in their study for evaluating a ground mobility device for Indian women (Fig. 2.23) noted the following reasons that present a mobility challenge for the disabled women in rural India.

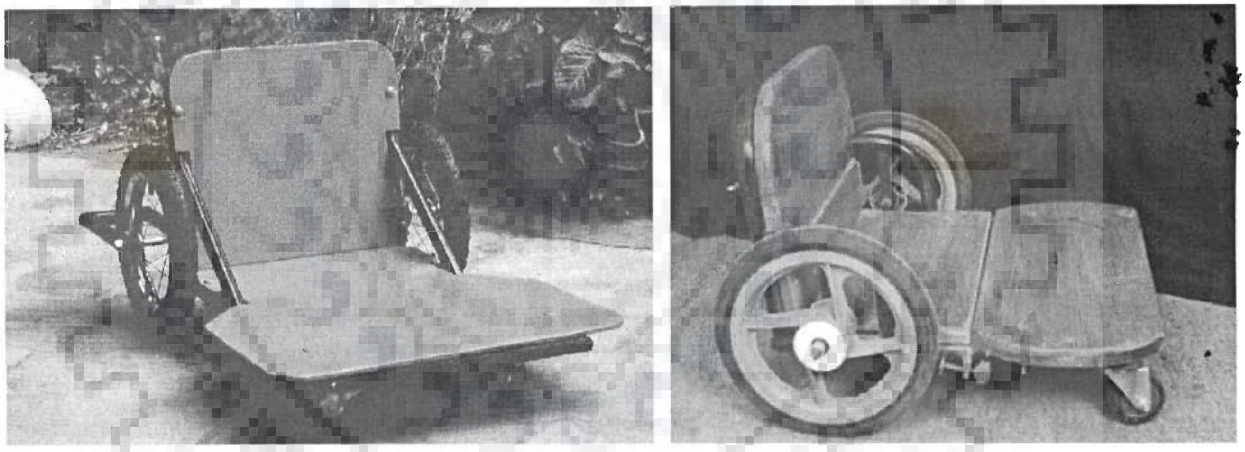


Fig.2.23 Indian low floor ground mobility devices (Developed at National Institute of Design, Ahmedabad, India in collaboration with Canada)

Firstly, women in India typically perform activities of daily living (self-care, work, leisure) both inside and outside the house. Physical barriers such as slopes, mud, rocks and steps are commonly encountered and the women often exposed to the elements. Wheelchairs were designed to travel indoors and outdoors over relatively smooth surfaces and often do not cope well with rough terrain.

Secondly, most activities are performed on or close to the ground, the floor being used as a work surface. For example, pots and clothes are washed whilst squatting on the ground and cooking is frequently done on a chulha (wood} dung burning stove commonly at ground height). Both the wheelchair and the tricycle position the rider at table height which means that dismounting would be necessary to perform ground height activities.

Thirdly; activities are commonly performed in locations within or in close proximity to the home. The tricycle was designed to travel relatively long distances and hence is too cumbersome to be manoeuvred within the home.

He concluded in his paper, ' Function and quality of life are paramount and should not get lost in, or overtaken by, mechanical and technical issues; the task is to always strive to design using local resources and with the absolute goal to meet the needs and preferences of the end user.'

Nichols, PJR (1976) suggests that prescribing and providing a wheelchair for a disabled person is always a compromise. The chair needs to be comfortable and safe, but yet also light. Frequently, it needs large wheels which the user can employ for propulsion purposes but large wheels make it long and awkward to manoeuvre and difficult to pack away into storage space or into a car. Comfortable footrests are also needed and yet once again the critical dimension of a wheelchair is its length or diagonal and the footrests extending in the front of the chair are frequently the awkward parts in getting round corners and getting in and out of toilets.

Goswami, A. *et al* (1986) reported that people with severe handicaps of both lower limbs that preclude standing and walking may use hand-cranked tricycles for outdoor locomotion, especially in the developing countries, like India, where economic considerations restrict the use of motorized wheelchairs. Although tricycles are used by a large proportion of such handicapped people in India, their scientific evaluation leading to

further cost efficient developments is scanty. They conducted a research evaluation study on a sample of 61 male lower extremity subjects (paraplegics) for anthropometric analysis of tricycle designs in India and concluded that neither of two available tricycle designs was anthropometrically compatible to disabled persons. They found that the seats did not provide a comfortable sitting. Although the hand crank was relatively well positioned in one, the distance of the crank from the back rest obliged the users to bend forward while driving their tricycles. The study concluded that suitable modifications in the dimensions of the tricycles were required to provide greater comfort, safety and ease of operation. Also, it was suggested to reduce the weight of the tricycle.

Hotchkiss, R. (1990) estimated, that out of 20 million potential wheelchair riders in the developing countries, less than 1% currently use any such device. Referring to the specific context of India, Deshpande, S. (in Lysck, J.T. *et al*, 1996) reported the need of wheelchairs to be of the order of 3 to 4million. Furthermore, he estimated the current Indian wheelchair production capacity of the order of only 20,000 units per year.

Lysack, T. *et al* (1996) in a paper on designing a short range wheeled mobility device for the women in India, stated, "logically different types of mobility devices are appropriate for different activities." They explained, "For example, a hand driven tricycle (a long-range device) would be appropriate for a rider with good upper body strength to travel several kilometers. For shorter distances, a wheelchair (a mid-range device) may prove to be more useful. For activities within and around the home, however, especially in cultures where many activities are traditionally performed on the floor, neither device is appropriate. In these situations, 'caster-carts' or 'floor scooters' are sometimes used."
For a rehabilitation technology design to be successful, he pointed that the technical, functional, economic and cultural environments must be well understood and accounted.

Gray, D. (2004) did an extensive research on the measures of environment. He emphasized on enhancing participation of persons with disabilities in activities of daily

living despite a low score in clinical settings. He supports his findings through the graphs presented in Figures 2.24 to 2.27. From the examples given below, he showed, although people with disabilities may score low in tests of capacity, they may participate in many life activities including work, education, family and community life (Fig. 2.24). Fig. 2.25 highlights the widened gap in the quality of participation by disabled people due to absence of good assistive technology. Fig. 2.26 focuses on the reduced gap, in the presence of good assistive technology while Fig. 2.27 highlights the elimination of gap in participation of disabled people with assistive technology, personal assistance and receptive environments.

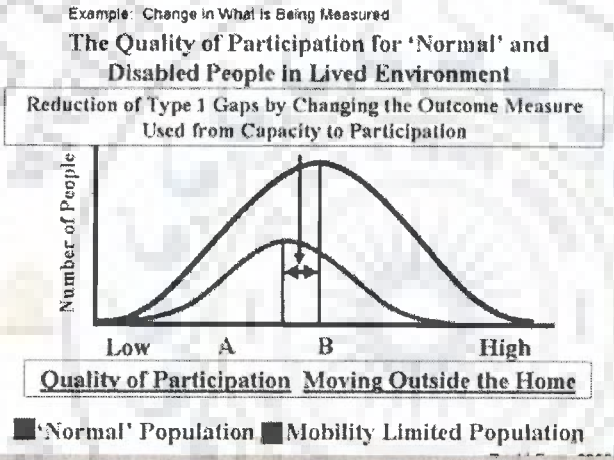


Fig. 2.24 Quality of Participation of Normal and Disabled people

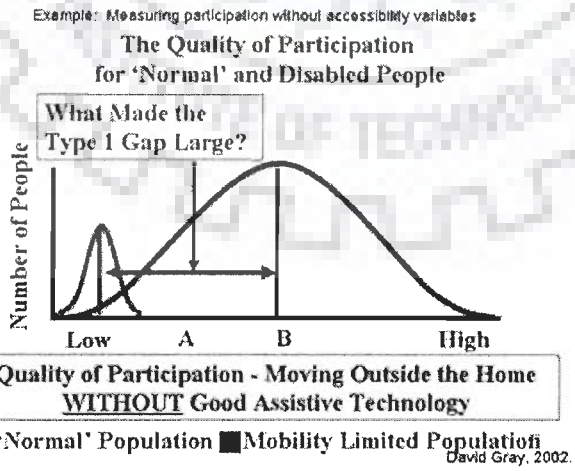


Fig. 2.25 Increased gap in the Quality of Participation of Normal and Disabled people

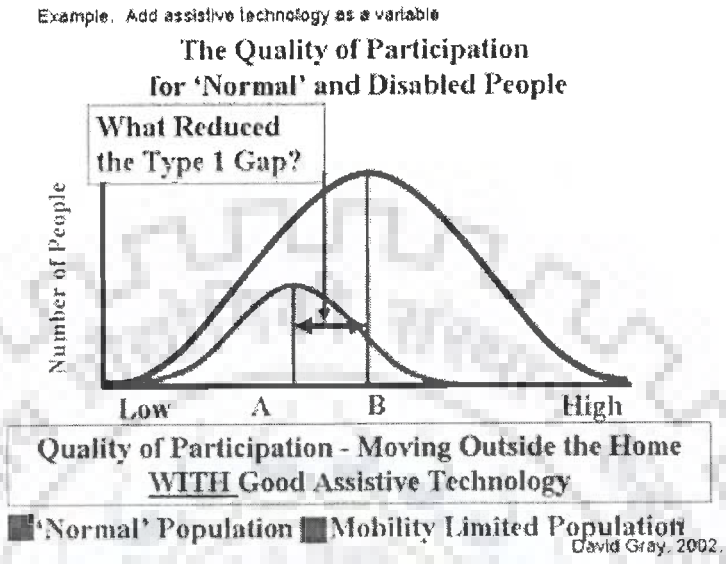


Fig. 2.26 Reduced gap in the Quality of Participation of Normal and Disabled people

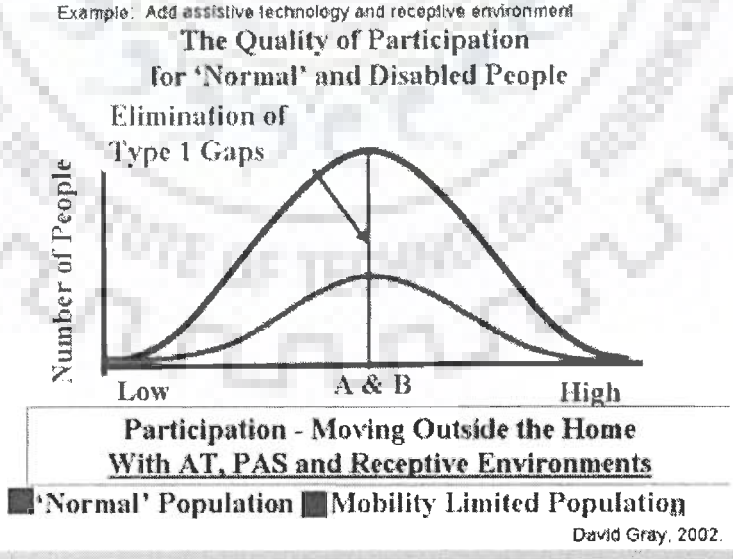


Fig. 2.27 Elimination of gaps in Quality of Participation of Normal and Disabled people (with Assistive Technology and Receptive Environments)

Johnson, D.O., *et al* (1996) noted, throughout the world's developing countries many small manufacturers of wheelchairs do not have the resources and technical background to test their products for safety and durability. While acknowledging the dual challenge of limited money and materials for manufactures, he suggests that they must provide to their customers, wheelchairs that are safe, durable, good performers and that are producible at affordable prices. He suggests some test which could be conducted on the wheelchairs being produced in the developing countries.

Kumar, V. *et al* (1997) reviewed the state of the art in the technology for assistive devices for people with disabilities, with a particular focus on the robotics technology. He surveyed the available methods for enhancing mobility (Table 2.6)

Table 2.6. A survey of available methods (technology) for enhancing mobility

Solution	Advantages	Disadvantages
Architectural modifications (curb cuts, ramps, accessible elevators)	Usually low cost to consumers. Assists all ages and abilities. Often a simple technology with low maintenance. High consumer acceptance.	Regulations do not apply to private or historic buildings. Apply only in limited measures to apartment buildings. Many buildings do not comply with the law. Not applicable in most outdoor settings.
Transfer technologies	Can transfer to the vehicle most appropriate for the environment.	May requires assistance with a transfer.
Stair climbing wheel-chairs	Allow access to certain wheelchair inaccessible environments.	Does not generalize to other environments, does not work on all types of stairs, often a bulky addition to the wheelchair, slow to deploy, poor maintenance.
Customized chairs (out door buggies) Optimized for the environment.	Optimised for the environment	Requires transfer.

Curb climbers	Low cost. For example, golf carts, outdoor chairs and special purpose sand buggies.	Suitable for only small obstacles, due to power limitations of the wheelchair.

Source: Kumar Vijay et al 1997, Assistive Devices for People with Motor Disabilities

He noted that disabled people are increasingly able to lead an independent life and play a more productive role in society. In the case of disabled children, such assistive devices have been shown to be critical to their cognitive, physical and social development (Butler, C.,1986).

2.7.2 Human Assistance

In the advanced (western) nations as a scenario, independent living movement has transformed the role of a disabled person from a client to a consumer, placing him in a more rights based society with a more participatory role rather than just being at the receiving end. (.McGettrick, G, 1994)

Disabled people in low income communities cannot afford to buy wheelchairs, crutches, walking frames and other assistive devices. It would be more practical and economical to carry a disabled person if they are not able to crawl or drag themselves. Even if assistive devices become affordable, it is questionable whether, in low income communities, disabled people are encouraged to be independent in mobility (Lewis, I et al, 2002).

While in the developing countries the most widespread aid for the physically disabled is the human assistance rendered by the family, friends and the local community. Family is the core point of helping disabled people if the [CBR] field worker can motivate/encourage them' (Mony, 2002). As noted by Jones,H. (2002), in some cultures it is a norm for the disabled person to be dependent and no one is aware of an alternative. She suggests discussing the concept of independence and its benefits with the disabled person and their carers in a way that empowers them. Families may

need to be encouraged to allow or stimulate the disabled person to be more independent.

2.8 CONCLUSIONS

An extensive amount of information from a range of relevant fields has been identified and reviewed. Substantial information could be gathered about access issues for disabled people in high income and urban areas, including access to water and sanitation facilities, but most of it is found to be not directly relevant to low income communities. This is because it was either only applicable in modern urban environments, or assumed a high level of available resources and expertise.

In the methodological context, several methodologies (like full scale modeling, FIM based measurement etc.) were reviewed. It could be concluded from the observations, that those methodologies were more relevant to controlled environmental settings like in laboratories etc. Also, they required training of the tools used for observation and analysis. Most of these approaches had an empirical basis of research and a quantitative analysis was deemed necessary for measuring the outcomes.

Various concepts of barriers were reviewed with major focus on highlighting issues related to activities of self care. Alternative design approaches to basic sanitation and other activities of daily living in the low income communities were reviewed. This added to the information documentation process for a healthy exchange of design ideas which may be locally adapted to diverse communities across the regions.

The need for further research in the areas of development of methodology, better understanding of barriers to performance of activities of daily living with socioeconomic and socio cultural perspectives and alternative design and rehabilitation approaches for low income communities in the developing nations has been greatly emphasized.

In general, the following conclusions may be drawn from this review,

1. Disablement process is a complex interaction between environment and the person. State of the art and traditional models of disablement were discussed.

2. There is a need to advance theoretical base to conduct studies on enabling environments especially with reference to rural contexts.

3. There was ample information available in the field of accessibility research. However, it relates much to the western context where the environments are much more standardized than the environmental context of the low income rural communities in the developing countries.

4. Measurement of functional assessment based on URS^{TM}, FIM^{TM}, Enviro FIM^{TM} was reviewed. Though, for measuring person-environment interactions in naturalistic environments not much information was available.

5. Various design approaches were reviewed in the order of their development. Universal design approach with a broader aim of inclusion of diverse user groups into mainstream is suggested to be the most appropriate for the rural Indian context, though it may be used it here with different terminologies.

6. Barriers to performance of Activities of Daily Living (For e.g. Toileting, Bathing) were reviewed. It was also found that predominantly access for sanitation activities needs greater emphasis than other ADLs.

7. Cost affordability and socio cultural context of the environment formed two major criteria in addition to other design criteria for appropriate design interventions in low income communities of developing nations.

8. Development of appropriate technology at affordable prices for assistive devices is largely felt to cater to the needs of persons with disabilities in low income communities.

9. No specific guidelines or codes were found for developing accessible rural environments in the developing nations.

It is clear from the literature cited that there are a number of issues involved in the process of enablement. These issues must be considered at a holistic level to transform into deliverable actions and implementable strategies on the ground. Failure to understand them as a whole may result into inappropriate decisions which may continue to exclude persons with mobility impairments from participation in their rural activities.

Chapter 3

RESEARCH DESIGN

3.1 INTRODUCTION

In chapter two, several theoretical aspects of disablement process were reviewed alongwith other relevant areas for this study. Various research approaches for the rural contexts in the developing countries were also reviewed to finally devise a research methodology for the present study. Various themes were identified which directly or indirectly affect the independence of the persons with mobility impairments in the performance of Activities of Daily Living and thus needed data collection in. They have been largely classified as personal and environmental (physical, social and institutional) parameters (Jones, H. et al., 2002). In the absence of reliable tools for conducting study in the naturalistic settings, a multi method approach was found suitable for this research study. The work presented in this chapter discussed the research design followed to conduct this research investigation.

3.2 RESEARCH METHODOLOGY

The study broadly follows a descriptive/exploratory approach as methodology for its conduct. A beginning through personal interest backed by small experience of work in the area of barrier free environments formed a base for an extensive sifting through literature to understand the background of accessibility research. Further discussions with experts from diverse yet related domains, led to the identification of the problem which further extended to the study of relevant literature from multidisciplinary perspectives. Research gaps were identified and a survey cum case study based methodology was thus adopted for the research investigations. Data collection formed one of the most challenging domains of this work in the lack of secondary data to conduct research at grass root level. Fig.3.1 shows a detailed research methodology chart.

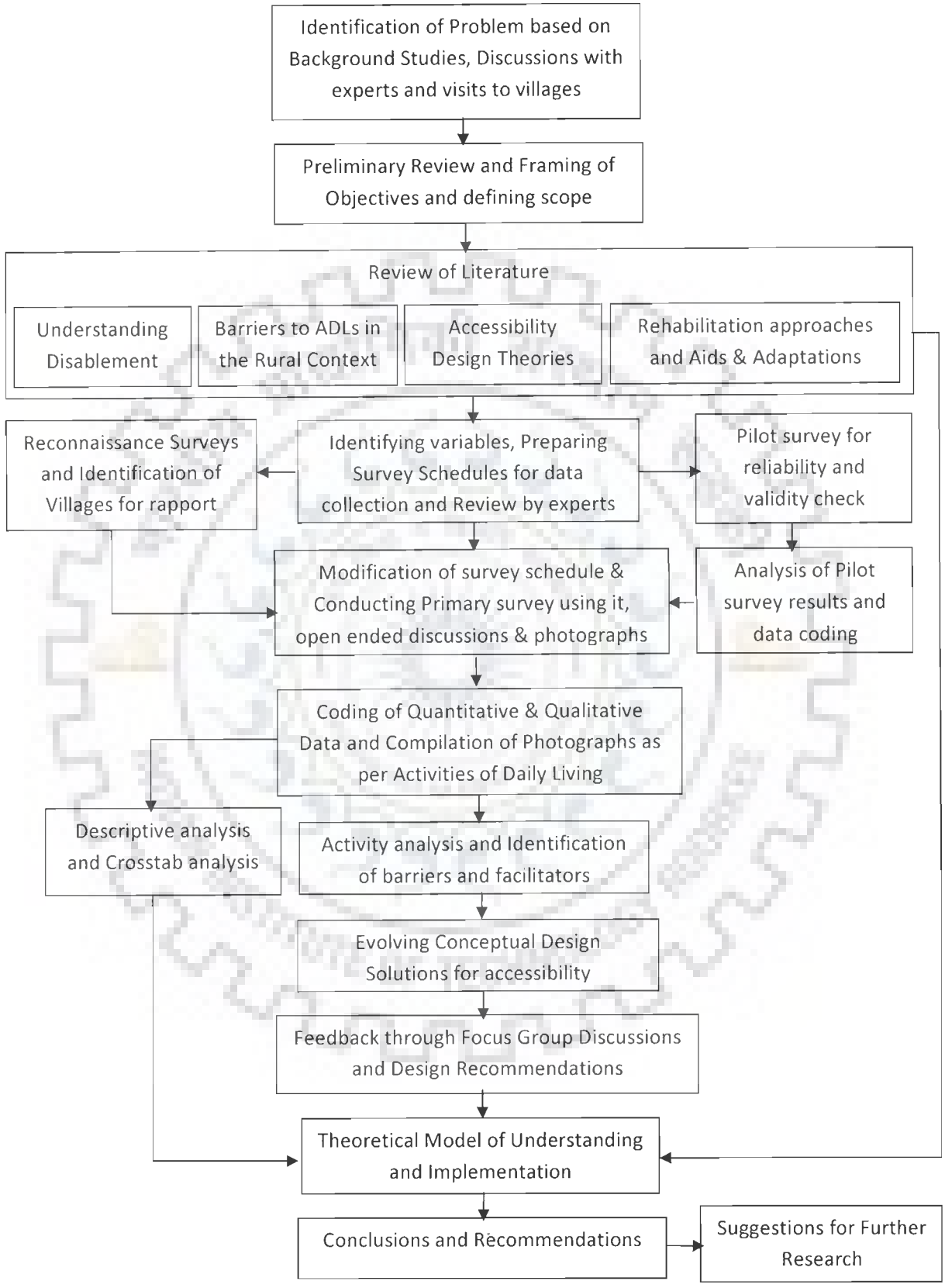


Fig. 3.1 Research Methodology Chart

3.3 STUDY AREA

3.3.1 Characteristics

Derived its name from 'Ruri' wife of a Rajput chieftain, the history of Roorkee as it stands today can be traced back to 1840, when it existed on a mud built village situated on the elevated bridge on the southern bank of Solani river, when the town was adopted by the British Indian Government with commencement of the construction work on famous Ganga Canal. Situated in the Indo Gangetic plains, overlooked by the mighty Himalayas, it is located at 29°51' N and 77°53' E at an altitude of 268mts. Famous for its pioneering educational and research institutions, Roorkee enjoys a unique place of distinction not only in its home state Uttarakhand but also at national and international levels. While the town is central and has its existence since the British Colonial times, the villages around have grown in large numbers over the years. It has a mixed population of diverse religious faiths which includes Hindus, Muslims, Jains, Christians etc.

3.3.2 Selection of Villages

The area selected for the study were the villages around Roorkee based on the following criteria :

1. The areas had to represent a rural environment.
2. The researcher should have familiarity with the settings and the local language of the area.
3. Support of the Village Administrative Heads (called *Pradhans, in local language*) to conduct the survey study.
4. Since the study required frequent visits for survey and a personal dialogue along with extensive initial efforts for rapport building, proximity of the researcher to the study area was an important criteria.

After the reconnaissance surveys, finally, 15 villages as shown in Fig.3.2 were selected in the Roorkee block for the study.

STUDY AREA MAP ROORKEE BLOCK

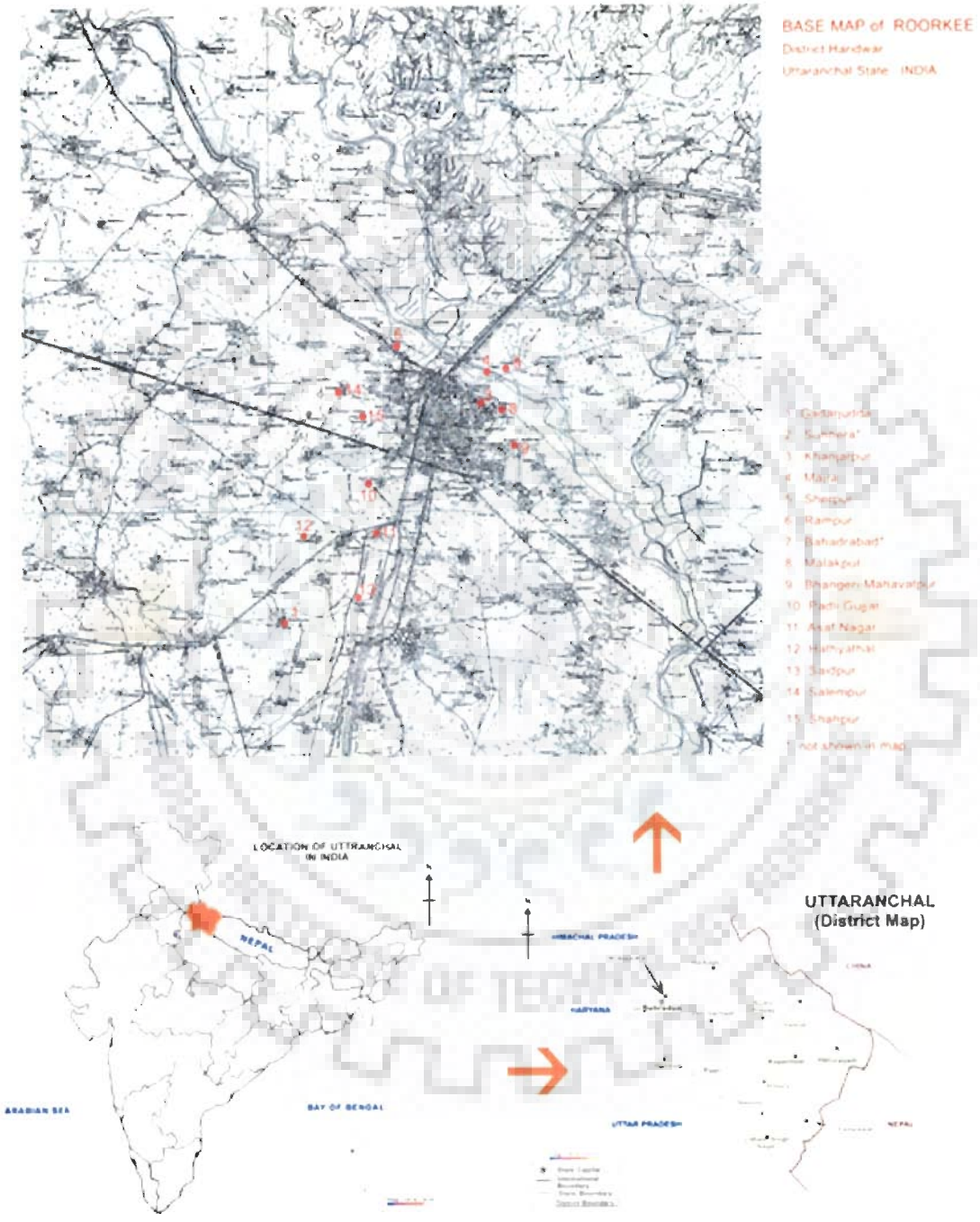


Fig. 3.2 a.) Map of India b.) Map of Uttarakhand State c.) Map of Roorkee block (study area)

3.4 DATA COLLECTION METHODOLOGY

3.4.1 Selection of Participants

Participants were selected based on the following criteria :

Inclusion Criteria

1. They had lower limb impairments (locomotor disabilities) with functional upper extremities.
2. They were permanent residents of the village under investigation.
3. They spoke Hindi, as the local language of the area.
4. They were able and showed voluntarily interest to perform simulation of Activities of Daily Living (ADLs).

Exclusion Criteria

1. Participants under the age of 9 yrs were excluded, as it was felt that the research theme would be too complex for them to understand and articulate.
2. People older than 60 years of age were excluded, as age determined mobility problems would be a confounding factor.

3.4.2 Sampling

In the absence of primary data of people with mobility impairments along with their identified locations in the study area, "network sampling" was used. While referring to the problems of data collection in developing countries, Mulholland *et al* (1996) notes that many persons with disabilities in developing countries are not listed with standard rehabilitation organizations or Non-Governmental Organizations. Thus, to identify persons with disabilities, one must be willing to rely on word of mouth and local assistance, such as asking local people if they know of any person with disability (mobility impairment). He thus, suggests "Network" (also sometimes called as "snowball") sampling approach to identify the specific survey participants.

3.4.3 Data Collection Framework

Rural environments of developing nations, in contrast to formalized urban setup characterize an informal living style of people suiting their low economic conditions. Data collection was thus a very challenging and tedious exercise owing to two primary reasons, viz. absence of structured or consistent guide appropriate for collecting data in developing countries and non availability of accurate database of people with mobility impairments (disabilities) at village level. Owing to the above challenges and available resources, using multiple data collection strategies was considered suitable to this research context (Mulholland, *et al,* 1996).

Reconnaissance surveys to several rural settlements in Roorkee block were made wherein discussions with the village administrative heads (*Pradhans)* were conducted briefing them about the research aims and its intent. They were also requested for their support in identifying persons with mobility impairments in their villages in addition to seeking permission to conduct a detailed investigation in their settlements. Subsequently, more visits were made to the same villages to develop rapport and hold meetings with the mobility impaired subjects and their families in those villages. This also helped in gaining general observations and understanding about the local cultures and other activities in performance. Finally, fifteen villages were identified for the final study, based on the availability of persons with locomotor disabilities in that village and quality of voluntary support offered for conducting the study. It required an extra effort to initially build rapport with the identified persons with mobility impairments and their families and then discuss with them the research intentions and probable outcomes.

3.5 Data Collection Tools

Data was collected through:

- Semi-structured interviews with informants - disabled people, family members and neighbours as appropriate.

- Observation and documentation of ADLs in their environments, through photographs.
- Detailed field notes of open ended discussions on how the mobility impaired subject carried out daily activities related to water and sanitation, including the informant demonstrating and explaining their use.
- Focus group discussions for feedback on conceptual designs

3.5.1 Semi Structured Interview

A number of different approaches could have been adopted from the formal structured interview to the unstructured focused interview and there were various considerations which had to be taken into account. There were various standard details that needed to be ascertained from all the participants, and the information gathered would need to be easily comparable between participants, so it seemed that a semi-structured interview would be most appropriate. Also, in an informal living structure of rural environments, it was natural expect subjective responses As these types of interviews are said to allow people to answer more on their own terms than the standardized interview permits, but still provides a greater structure for comparability over that of the focused interview."

Standard questions can be asked, but there is freedom for the interviewer to explore beyond the answers for "clarification and elaboration." The questions in a semi structured interview form the structure, or basic guide for the interview, and the interviewer can then adjust the discussion to suit the situation.

3.5.2 Observation and Photo documentation

Photo documentation is a survey tool to gather reliable data. ADLs performance by mobility impaired subjects in the rural environments required to be documented for a better understanding of the overall issues related to the person -activity-environment interface. Mulholland, et al (1996) noted that observation and in situ recording form an

important survey tool and still photographs also provide an accurate depiction for future reference. According to them, they serve four potential purposes :

1. They may be used to supplement and clarify data collected using other methods i.e. photographs of a woman cooking may confirm a written description of her working posture.
2. Photographs may be used independent of any other data i.e. a photograph of a stove enables one to conceptualize the challenges faced by the persons with disabilities in performing cooking activities.
3. Taking and leaving photographs of the persons with disabilities and family greatly enhances rapport and is much appreciated "reward" for participation in the project.
4. The photograph provides a medium by which to concisely and accurately convey information to others, especially upon returning home.

3.5.3 Focus Group Discussions – a participatory approach

Focus groups are a relatively recent form of qualitative research method, used widely in sociological, and anthropological applications. This tool relies on group interaction, with participants encouraged to question each other, rather than exclusively relying on a structured set of questions from an interviewer as commonly applied in one-to-one interviews. In the context of this study the researcher took the role of the moderator to guide the session and several participants to take feedbacks on the design issues.

In this sense the focus group has certain advantages over the individual interview as it allows participant's reasons for their beliefs and views to be explicated by inherent and to some extent natural means – through the other participants questions and dialogue, which in turn can avoid the necessity for the interviewer to have to ask the often difficult question – *why*?

Qualitative research methods are concerned with gauging participant's own accounts and expounding their attitudes, motivations and behaviour. A focus group can be defined as a carefully planned discussion to obtain perceptions on a defined area of interest in a permissive, nonthreatening environment. It is conducted with approximately seven to ten people by a skilled interviewer. The discussion is relaxed, comfortable, and often enjoyable for participants as they share their ideas and perceptions. Group members influence each other by responding to ideas and comments in the discussion. (Kreuger 1988: 18)

3.6 DESIGN AND CONSTRUCTION OF SURVEY SCHEDULE

Expert opinion was taken from the fields of architecture, design, disability& rehabilitation, occupational therapists and social scientists while designing the interview schedule for this research study.

3.6.1 Objectives of the Survey

1. To collect data with respect to personal, socio economic, disability, rehabilitation and activities of daily living perspective.
2. To develop more insight into the issues, perceptions and needs of the mobility impaired in the rural communities.
3. To develop an understanding about their socio cultural environment.
4. To get a visual photo documentation for further study of the problems related to access for performance of their ADLs.
5. To elucidate and articulate as diverse a set of points of view regarding the problems/issues related to mobility impaired and their performance of ADLs.

3.6.2 Designing of Survey Schedule

Survey schedule was designed in two parts. Part I comprised of structured interview based questions and was aimed at collecting objective data in the categories of Personal Information, Household information, Socio Economic parameters, Disability parameters,

Postural limitations and Rehabilitation based preferences(Ref. Appendix IA). The interview schedule was specifically designed for collecting the following information :

1. Personal Information such as name, age, caste, gender, religion etc.
2. Household Information such as no. of family members, family type, type of house, toilet facility, household/family income
3. Socio Economic information
4. Disability information
5. Postural Limitations
6. Rehabilitation Information

Part II of the survey schedule focused upon collecting data related to Activities of Daily Living in a semi structured format. It had questions (Ref. Appendix IB) related to the performance of ADLs, perceptual response about degree of difficulty, the environmental context of performance (regarding where and how they perform their activities), and related issues of identifying barriers to access and some discussions on directions for alternative solutions. Also, in this part, the respondents were asked to rate their perceptual experience of degree of difficulty in performing the activities of daily living (Refer Method of Scoring).

Further data comprised of observations and discussions with the survey participants and their family members based on simulation of the ADLs in their own built environment. These simulations were photo documented and discussions recorded to derive important directions to understand their issues and hence devise an approach for solutions.

3.6.3 Pilot Study

A pilot study was conducted for a field trial of the survey schedule. 10 samples (participants) were purposively chosen in 4 villages to test the reliability and validity of the survey schedule through it. The data was collected and compiled to develop an analytical

framework. These cases were not included in the final study. For measuring the perception of difficulties in Based on the difficulties faced and experience gained, the survey schedule was modified to avoid ambiguity and increase clarity so that appropriate responses could be obtained. It was found that the schedule is measuring what it proposes to measure and the sensitivity of the schedule was satisfactory.

3.6.4 Method of Scoring

The activities selected for detailed observation were Fetching water, Toileting and Bathing. The total experience of difficulty in performance of these ADLs was measured through Perceptual Experience Rating (PER) which was derived as a concept from the bipolar Usability Rating Scale (URS^{TM}). PER also followed two steps, while the second step was kept as five point unipolar scale (very difficult, difficult, neither difficult nor easy, easy, very easy). The Usability Rating Scale (URS^{TM}) was tested at the pilot study level and it was found that the respondents had two major difficulties

1.) To discriminate their choices was difficult in a 7 point range

2.) The concept of negative and positive on the bi polar scale could not gain acceptance due to their low education levels.

Hence, a five point unipolar rating scale was then developed and used for scoring in the study which was easier to comprehend by the participants. Their responses were found to be consistent as was tested during pilot study and was thus considered reliable to measure their perceptual responses.

3.7 ADMINISTRATION OF SURVEY

The survey schedule was self administered and the interview sessions varied in length from 1.5 to 3 hours to complete. The first phase of the interview involved a structured set of questions focusing on socio demographic information while the second phase was focused towards the qualitative responses about the activities of daily living. The responses of the survey participants were taken in the form of detailed field notes,

measurements of their spatial environments and photo documentation of the activities under observation (as performed by the participants). For the second part of interview which involved discussions and simulation of ADLs in their environment, a key issue explained to each person interviewed was that there was no such thing as correct response as each response was an expression of their perception. Their individual perceptions were noted and further discussions to identify environmental barriers and facilitators to access were highlighted. Also, suggestions were sought for improvement of their present environments for better performance of ADLs. The rural environments being very informal in structure, involved family and friends of the person with mobility impairments in a spontaneous manner. All interviews were conducted in the respondents homes and activities simulated in their natural environments.

3.8 DATA ANALYSIS

The data after collection was classified into two broad categories viz. Quantitative and Qualitative. Quantitative data included information related to socio demographic characteristics of the respondents while qualitative information pertaining to ADLs was gathered in the form of field notes, observation sketches and photographs. Further, the quantitative data was coded and inserted in the form of tables using SPSS 13.0 software which was then used for generating descriptive analysis in the form of frequency distributions and cross tabulations. Based on the theories of qualitative analysis (grounded theory, tacit knowledge), the qualitative data related to various activities of daily living was compiled under various categories/themes. Photo documentation was considered a very useful tool to document the process of activity performance. It also aided activity description and identification of barriers and facilitators in the study area environs. Conceptual designs were generated based on ADLs observations, discussions and suggestions by the respondents or their family members. Through focus group discussions, their feedback was elicited leading to final design recommendations.

White, H. (2002) concluded in his paper on combining quantitative and qualitative approach for poverty analysis, "Both quantitative and qualitative techniques have their

place in social analysis. There is no reason to give primacy to one over the other. Different methods are required to tackle different problems, and a combination of techniques will frequently yield greater insight than either one used in isolation." He noted that the role of research is to establish patterns in data rather than force them into preconceived view of the world.

3.8.1 The Grounded Theory Approach

The grounded theory method guided data collection and analysis (Glaser and Strauss, 1967). Grounded theory is derived from the sociological theory of symbolic interactionism (Blumer, 1969) and is used to model phenomena about which little is known. It is an inductive process approach, with an emphasis on social dynamics. The basic tenet of symbolic interactionism is that people construct meanings about their lives on the basis of interactions they have with other people. Edwards, T.C., *et al* (2002) discussed the application of grounded theory in developing a conceptual model for adolescent quality of life. They recommend it as a very useful and a reliable tool to gather data from respondents as it allows them to articulate their responses.

3.8.2 Tacit Knowledge

This approach, using dialogue to better understand user needs, has been successful for revealing tacit knowledge (Polanyi, M., 1966). When an individual shares their personal perceptions, which are based on their experience this can give the designer insight into the factors that influence a disabled person's experience of an environment. Luck, R. (2003) concluded in her paper on a dialogues in participatory design that tacit knowledge, giving insight into user experience of an environment, can be revealed through discussion. She also found that descriptive metaphors and narratives can reveal tacit knowledge and the semi-structured interview revealed explicit and tacit knowledge through the social process of discussion.

3.8.3 Participatory Design Process

Participatory design approaches are considered to reflect design as a social process, illustrating that the sphere of the design activity extends beyond. In this project, a practical low-cost method was used with great success. This method emphasized user feedback by continually approaching the user with simple, focused models which were designed to stimulate user feedback and not necessarily to immediately provide a 'best' design.

3.9 LIMITATIONS AND GAPS

Selection of the field visits, either to homes or to institutions was largely opportunistic in the way that contacts were made. An effort was made to ensure a balance of visits in terms of type of facility/ adaptation, the range of impairments which people had, and to both disabled women as well as disabled men. However, there remain some limitations and gaps in this study:

1. The study was limited to a small sample size of homogeneous nature.
2. Subjects chosen for study did not include persons with other disabilities other than people with lower limb impairments.
3. The study was limited to the study of activities of daily living with major focus on activities of self care (fetching water, toileting & bathing) only.
4. The designs proposed as concepts after discussions with the survey participants could not be built as prototypes within the scope of this research.

3.10 FORMAT OF PRESENTATION

Data and observations gathered during field survey are analyzed in the following two chapters. Results from quantitative analysis comprising socio economic, socio cultural and other demographic features have been discussed in Chapter 4 while the qualitative analysis of the performance of activities of daily living by the chosen subjects has been documented, analyzed and discussed in Chapter 5.

Chapter 4

RESULTS & DISCUSSION

4.1 INTRODUCTION

The main focus of this study was to understand in a holistic way, the various aspects of persons with mobility impairments living in the rural environments. Environments being constituted by the physical, social and institutional frameworks, it was important to collect data from the study area, relevant for this research. This chapter thus deals with the socio demographic information of the mobility impaired participants of the study which was collected through a self administered survey in the study area. Results from the data analysis of the interview schedules and the observational data from the survey undertaken specially for this study have been presented in this chapter. The interview schedule (Refer Appendix IA) prepared for this study were grouped in the following categories :

Section - I

1. Personal Information / Demographic Parameters
2. Household Information
3. Socio Economic Characteristics
4. Disability Information
5. Postural Limitations
6. Rehabilitation Preferences

Section - II

7. Activities of Daily Living based information

   This was further sub grouped into the following categories

   a. Mobility based ADLs
   b. Transfer based ADLs

c. Self care and Sanitation based ADLs

d. Occupation based ADLs

e. Community Participation based ADLs

In addition to the above information, the participants were asked to simulate these activities to give the investigator the real idea of the barriers to access and inclusion they face. And then the problems were discussed as an open ended discussion with family members, friends from neighborhood etc. as contributors too. This chapter deals with describing the data collected from the field studies as a part of the survey. It further elaborates the idea of the same and deals with the lower level of analysis.

4.2 DEMOGRAPHIC PROFILE OF THE RESPONDENTS

4.2.1 Age Group

Survey respondents can be broadly categorized in four age groups as shown in Fig. 4.1. Out of a total number of 43 respondents, six (13.95 %) belong to the age group of less than 12 years, 26 respondents (60.47 %) belong to the age group of 12 – 25 years. 9 respondents (20.93 %) were in the age group of 25 – 45 years while 2 respondents (4.65 %) fall in the category of > 45 years. The sample group is an indicative of the fact that most number of respondents comprised of suggests that the sample was distributed into the age groups of children, adults and elderly. This was done based on the criteria of mobility and the ability to participate in the discussion as children below 9 yrs of age group were not able to participate in the interview process.

Majority of the participants being in the age group of 12-25 years and 25 – 45 years aided the research study to understand the issues and perceptions related to mobility and other activities of daily living from the adult age perspective. These age groups were considered as the most productive years of life to contribute either in the household economy or other household work. The higher age group participants were deliberately excluded as

with age, problems of mobility are compounded by other disabilities which add a bias in the study.

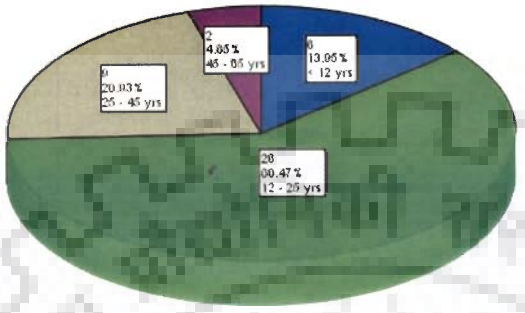


Fig. 4.1 Chart showing frequency distribution in age groups

Fig. 4.1 shows the distribution of participants on the basis of age groups. The forty three participants who participated in the study ranged in age from 9 to 60 years. 6(14%) belonged to less than 12 years of age, while 26(60.5%) were in the age group of 12 – 25 years. 9(20.9%) were in 25 – 45 years of age group and 2(4.7%) participants in the age group of 45 + years. The sample largely had adult populations who were able to share their issues related to Activities of Daily Living and were able to simulate. Since the focus was only on mobility impaired, elderly people were excluded from the sample as they are vulnerable to other disabilities, illness and compounded with problems of age.

4.2.2 Gender

The sample of survey participants had 29(67.4%) male and 14 (32.6%) female members (Fig.4.2). The member had a good representation of female members. It also removed the myth that village women were not participative in the fore front. Rather, their responses have played a crucial role in understanding the issues at a holistic level.

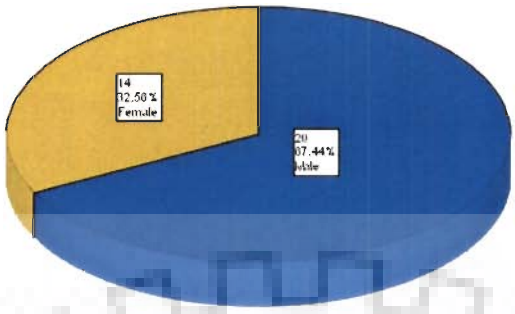


Fig. 4.2 Frequency distribution of respondents on the basis of Gender

It was important to include both genders to study the dependencies in the performance of ADLs and participation in the rural setups from both perspectives. For example, Women played greater role in household maintenance while men were responsible for outdoor works under a general circumstance. It thus became imperative to study, how men and women with mobility impairments participate in their daily routine at a village community level. Though, the researcher had an assumed notion about women in the rural environments that they or their family members may not participate in this survey study. This view got contradicted in the very first few visits to the rural settlements through an enthusiastic, whole hearted participation by the female members and their family members despite the absence of a female interviewer. This created congenial environments for a better understanding of their issues and an unhindered flow of ideas. The Indian Census (2001) survey figures (Table 1.2) also indicate that male members have a greater incidence of locomotor disabilities than women.

Table No. 4.1 Gender v/s Age Crosstabulation

			Age				Total
			< 12 yrs	12 - 25 yrs	25 - 45 yrs	45 + yrs	
Gender	Male	Count	3	18	6	2	29
		% of Total	7.0%	41.9%	14.0%	4.7%	67.4%
	Female	Count	3	8	3	0	14
		% of Total	7.0%	18.6%	7.0%	.0%	32.6%
Total		Count	6	26	9	2	43
		% of Total	14.0%	60.5%	20.9%	4.7%	100.0%

Table 4.1 shows the cross tabulation between gender and age groups. It shows the distribution of sample in their respective categories of age group and gender. It indicates that the sample constituted of most men and women from the age group of 12 – 25 years i.e. 18(41.9%) men and 8 (18.6%) women respectively.

4.2.3 Educational Status

13 (30.2%) of the respondents were totally illiterate as they had never received any school education. 6(14%) had received or were studying in the primary education level. 20(46.5%) had completed or failed in High School while only 4 (9.3%) had a background with an education status upto Intermediate level. Fig. 4.3 indicates a graphical representation of the education status of the survey sample. This was generally either due to lack of education facilities (like school etc) at village levels or problem of mobility to a school located quite far from the village in Roorkee town (3 to 5 kms). or lack of affordability. One more factor which has been observed by one of the respondents has been a discouraging attitude reflected by the school teacher by scolding the child with mobility impairments, which made her lose interest in going to the school. Though, most of the family members displayed a clear understanding of the need and importance of education and mentioned it as the only possible way of making them economically sound despite disability.

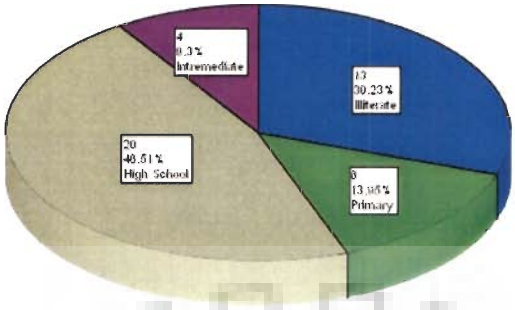


Fig. 4.3 Chart showing frequency distribution of Education

Further, the crosstab analysis as shown in Table 4.2 suggests that majority of both male and female participants (70%) were either studying while 9(20.9%) male and 4(9.3%) female participants were illiterate. It was observed that though rural environments characterize low levels of education, most of the survey participants had a keen interest in studying in addition to having a good support by their family members. A change in the rural thinking in opposition to traditional thoughts was apparent in this respect. However, there were still few participants who were illiterate. This was due to either low economic status or their personal limitation of very low degree of mobility or long distance of school from their home.

Table 4.2 Gender * Education Crosstabulation

			Education				
			Illiterate	Primary	High School	Intremediate	Total
Gender	Male	Count	9	3	14	3	29
		% within Gender	31.0%	10.3%	48.3%	10.3%	100.0%
		% of Total	20.9%	7.0%	32.6%	7.0%	67.4%
	Female	Count	4	3	6	1	14
		% within Gender	28.6%	21.4%	42.9%	7.1%	100.0%
		% of Total	9.3%	7.0%	14.0%	2.3%	32.6%
Total		Count	13	6	20	4	43
		% within Gender	30.2%	14.0%	46.5%	9.3%	100.0%
		% of Total	30.2%	14.0%	46.5%	9.3%	100.0%

Table 4.3 Age vs Education Crosstabulation

			Education				Total
			Illiterate	Primary	High School	Intermediate	
Age	< 12 yrs	Count	2	3	1	0	6
		% of Total	4.7%	7.0%	2.3%	.0%	14.0%
	12 - 25 yrs	Count	6	3	14	3	26
		% of Total	14.0%	7.0%	32.6%	7.0%	60.5%
	25 - 45 yrs	Count	4	0	4	1	9
		% of Total	9.3%	.0%	9.3%	2.3%	20.9%
	45 - 65 yrs	Count	1	0	1	0	2
		% of Total	2.3%	.0%	2.3%	.0%	4.7%
Total		Count	13	6	20	4	43
		% of Total	30.2%	14.0%	46.5%	9.3%	100.0%

Table 4.3 suggests that there were quite a few respondents in the age group of 12-25 yrs who were either educated upto high school or were studying in that class during the time of survey while 3 of them had been able to receive education upto intermediate level. In contrast to it, there were 4 (9%) respondents in the age group of 25-45 yrs who were illiterate while also in the age group of 12 – 25 yrs, there were 6 (14%) respondents who were illiterate.

Table 4.4 given below shows a cross tabulation between the degree of mobility of the participants and their educational status. Many of the ones who were illiterate were found to have a very low degree of mobility as they were unable to leave their home environments. While the ones who had a greater degree of mobility were able to move to the school even some distance away for education. However, there were several other factors like proximity of the school, level of school, affordability of the school fees (for higher classes) and most importantly their will to be educated that affected their educational status.

Table 4.4 Degree of Mobility * Education Crosstabulation

			Education				Total
			Illiterate	Primary	High School	Intremediate	
Degree of Mobility	Unable to leave home	Count	7	1	1	1	10
		% of Total	16.3%	2.3%	2.3%	2.3%	23.3%
	Immediate vicinity	Count	2	3	11	0	16
		% of Total	4.7%	7.0%	25.6%	.0%	37.2%
	Within the Settlement	Count	2	2	8	3	15
		% of Total	4.7%	4.7%	18.6%	7.0%	34.9%
	Upto the Nearby Town	Count	2	0	0	0	2
		% of Total	4.7%	.0%	.0%	.0%	4.7%
Total		Count	13	6	20	4	43
		% of Total	30.2%	14.0%	46.5%	9.3%	100.0%

4.2.4 Villages

The table given below shows the number of respondents from each of the 11 villages in the study area.

Table 4.5 Frequency Distribution of survey participants in the Study area

S.No.	Name of Village	No. of Participants
1	Bhangeri Mahavatpur	08
2	Malakpur	04
3	Khanjarpur	05
4	Majra	05
5	Sherpur	03
6	Salempur	03
7	Sunehra	05
8	Rampur	04
9	Padli Gujjar	02
10	Shahpur	01
11	Rasulpur	03
	Total	**43**

4.2.5 Religion

Fig. 4.4 shows that 30(69.8%) of the participants were of Hindu faith while 13(30.2%) respondents were from Muslim religion. This allowed the researcher to have a better idea of the socio cultural diversity which is quite evident in Roorkee block as a town. Coexistence with diverse beliefs in the same villages was a very positive feature of these villages. It was also observed that respondents representing both the faiths had a strong belief in God. Religion, as discussed here has a perspective of a way of living and performing activities in typical areas. This plays a great role in understanding the socio cultural environment.

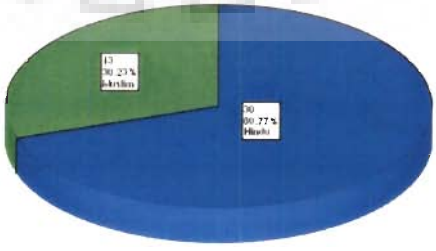


Fig. 4.4 Chart showing frequency distribution of Religion

4.2.6 Marital Status

33 (76.4%) of the respondents maintained their marital status as single. Of which almost 10 were in the marriageable age groups as 18 to 24 years. Only 8 (18.9%) of the respondents were married while 1 (2.3%) respondent (female) was separated and 1 respondent (2.3%) was widowed. (Fig. 4.5)

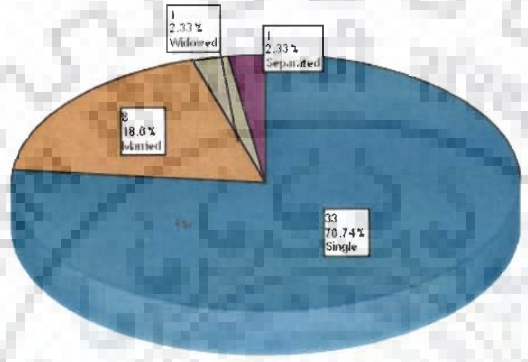


Fig. 4.5 Frequency distribution of respondents based on Marital status

Following qualitative statements would help in illustrating the issue of marital status:

Farhat (respondent no. 39) was separated by her husband at the age of 40 years, due to her disability. She had got her left limb amputated as a result of a road accident.

Meera Devi (respondent no. 10), never got married as she is disabled. So she lives with her elderly father of 65 years of age.

Ram Kishore(respondent no. 6), dropped the idea of getting married when he got his lower limbs paralysed 2 years back. He is 21 years of age now. His family members though quite depressed with the disability, are trying to convince him to reconsider his decision.

Randheer (respondent no. 13) said, "Of course, I have to get married. After all marriage would give me some support."

Wives of Rakesh (respondent no. 20) and Arvind (respondent no. 36) also had locomotor disabilities. Yet, amongst all cases, the role of spouse as a caregiver and in the management of household works was phenomenal. For example Pankaj's wife helped

him in running his shop, while Babli (respondent no. 19) reared children when Rakesh used to go to fields as a farm labour. Others who were not married, either due to age or due to disability had their parents assuming the role of caregivers.

4.2.7 Family Type

Fig.4.6 shows that 26 (60.8%) of the respondents belonged to Nuclear family setups while 17 (39.2%) respondents belonged to a Joint family system. The type of family setup had a great impact on the mobility impaired individual. It was observed that since joint family setup had greater number of family members, it was used as a strength to provide human assistance or care givers to the mobility impaired member of the family. Moreover, there was more social interaction within the home itself. While in a nuclear family, whole responsibility was on one head which couldn't be divided further. In case of low incomes, joint family system was also difficult to manage, with more number of members to feed.

Fig. 4.6 Frequency distribution of respondents based on Family Type

4.2.8 Family Size / Household size

Fig. 4.7 shows the distribution of household size categories amongst the survey participants. 14(32.6%) respondents had less than 5 members in their families. 23(53.5%) participants belonged to families with 5 – 10 members per family. This also had nuclear as well as joint families. The number of members in some cases was an added botheration

due to low socio economic status. As a result, it led to even more deprivation and social insecurity. While there were more than 10 family members in 6(14%).

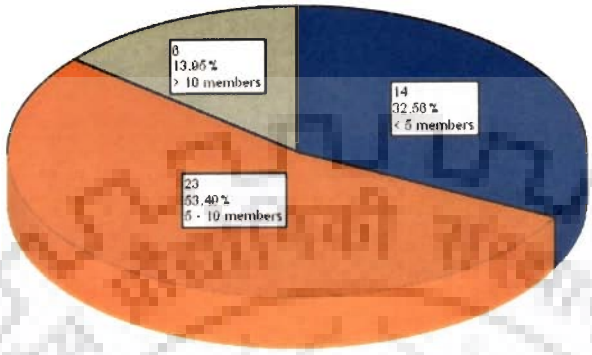


Fig. 4.7 Frequency distribution of respondents based on Household size

Generally, the size of family is known to have an influence on its socio economic condition. Because, if the dependents are more, the family resources are also divided as the disabled member of the family demands relatively more time and financial resources compared to other members in the family.

4.2.9 Relationship to Family Head

7(16.3%) respondents were themselves the family heads while in 34 (79.1%) cases, either father or mother was the family head. In 1 (2.3%) of the cases, the respondent with disability was the spouse of the family head.

4.3 HOUSEHOLD PARTICULARS

4.3.1 Type of House

There were primarily three type of dwellings on the basis of their construction type. Fig. 4.8 shows that 6(14%) of the respondents lived in Kutcha houses while 17(39.5%) of the survey participants were living in Semi pucca houses. Almost half 20 (46.5%) of the respondents lived in Pucca houses. Kutcha houses were usually made of mud or mud

brick walls, while semi pucca houses were made of brick bonded with mud mortar, while pucca houses had cement plastered brick walls.

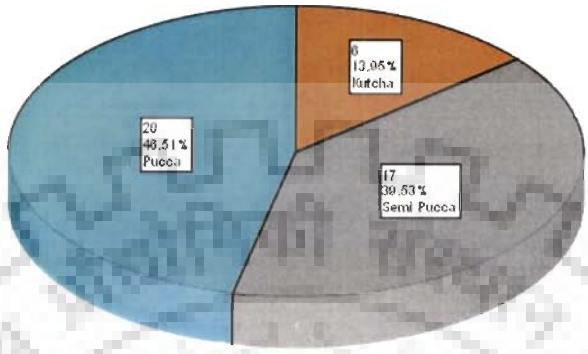


Fig. 4.8 Frequency distribution of respondents based on Type of House

There were various similarities in the planning of the rural houses (Refer Appendix III). All houses had a high threshold at the entrance flanked by a drain on its front side. Further, there was a large unpaved open space (usually in mud flooring) which was used for multipurpose activities like cooking, sitting, washing etc. Also, a hand pump as a water source was found mostly in the courtyard with its water being discharged in the outside drain. If the house had a toilet and bathing facility, it was usually located towards the entrance wall which was the end of the house from the other side. Beyond the courtyard used to be a semi covered space with two or three rooms along its length. The rooms inside had no specific layouts.

4.3.1.1 Roofing Types

Fig. 4.12 shows that 6(14%) of the participants had houses with Thatch or Battened roof. Jack arch roofing was found to be the most prevalent in the 33(76.7%) cases. This was considered to be a a cost effective way of roofing without concreting and yet strong enough to withstand the external weather changes. 2(4.7%) houses had reinforced brick concrete(RBC) and 2(4.7%) houses had reinforced cement concrete roofings.

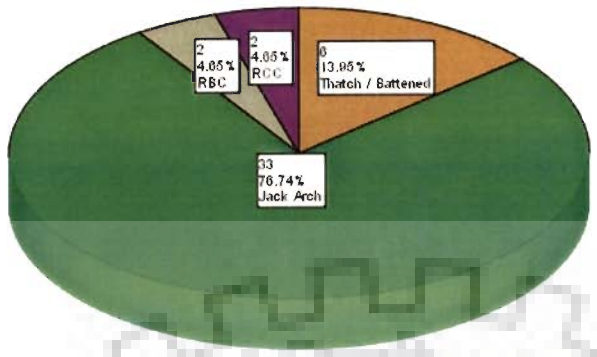


Fig. 4.9 Frequency distribution of respondents based on Type of Roofing

4.3.1.2 Walls

Walls formed the enclosure of space, while their material enhanced or reduced their durability and maintenance as the prime issues of concern. Plastered, unplastered brick and mud bricks were observed as the most prevalent types of walling material in the houses of survey participants. Most of them 24(55.8%) had plastered brick walls with 13(30.2%) of the houses in unplastered brick masonry. Only 6(14%) of the respondents were living in houses with mud brick walls (Fig. 4.10). It was found that all the respondents whose houses had mud brick walls were economically very poor with a household income in the category of less than Rs.1000/- per month.

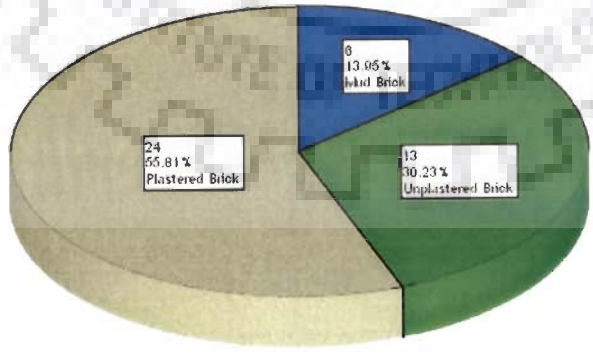


Fig. 4.10 Frequency distribution of respondents based on Type of Walling

4.3.1.3 Flooring Types

20 (46.5%) respondents had compact earth as their flooring base while in 13(30.2%) cases, participants had used brick coba for their flooring. Only 10(23.3%) participants had PCC as their flooring base. The flooring material had a great role in enabling or disabling one's mobility in their environment. Soft floors like mud flooring had an advantage for those who had to crawl for their mobility needs. However, during rains it gets washed away and needs to be redone. Cement flooring (PCC) is hard and expensive but easy to maintain. It becomes slippery when it gets wet. Flooring Types had a direct impact on the mobility of the participants as some were mentioned to be hard enough to provide stability to stand, others would get swampy but had an advantage of not hurting the one who would fall on that.

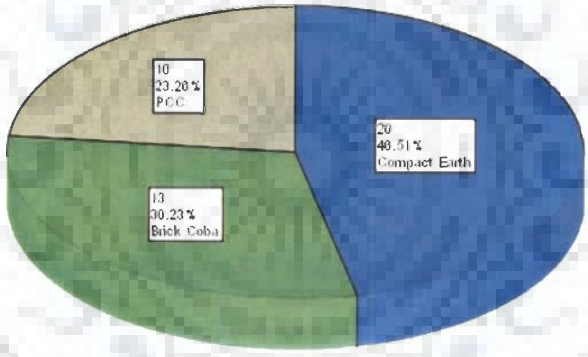


Fig. 4.11 Frequency distribution of respondents based on Type of Flooring

4.3.2 Services

4.3.2.1 Electric Supply

32(74.4%) households had electric supply in their houses in contrast to 11(25.6%) respondents who had no electric supply in their households. The major use of electricity was for mechanical ventilation using fans, use of lights especially during night and to run televisions for entertainment. However, the streets of the villages in the study area were poorly illuminated.

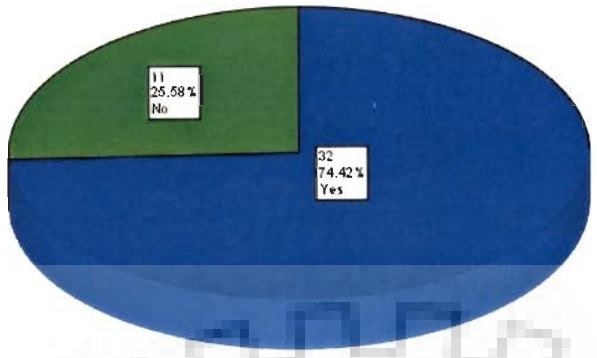


Fig. 4.12 Frequency distribution of respondents based on Supply of Electricity

4.3.2.2 Water Supply

Water supply in rural households and external environments was through a community hand pump, personal hand pump and/or piped water supply. Survey results show that most participants 24 (55.8%) had a hand pump installed at their own homes while 2(4.7%) respondents had a piped water supply facility in their homes. 17(39.5%) respondents depended upon a community hand pump in vicinity for their daily water based needs. Availability of water source in the proximity was of great importance for performing basic activities of self care and sanitation.

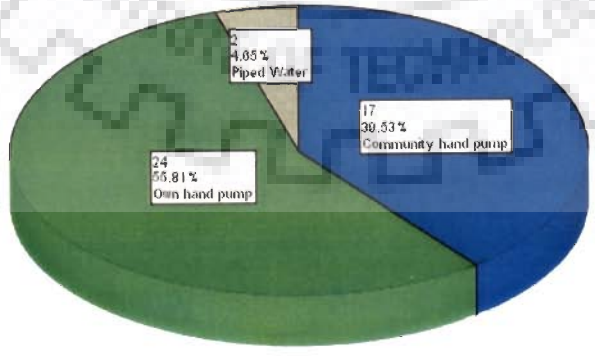


Fig. 4.13 Frequency distribution of respondents based on Water Supply

4.3.2.3 Toilet Facility

24(55.8%) participants had a toilet facility in their homes while 19(44.2%) respondents had no toilet facility at their homes. The crosstab analysis (Table 4.3) shows that majority of the households who did not have a toilet facility at home had low family/household income in the range of Rs.2000/- per month.

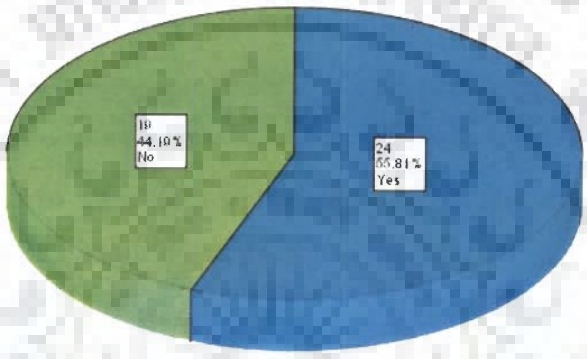


Fig. 4.14 Frequency distribution of respondents based on Toilet facility

4.3.3 Socio Economic Status

The socio economic condition of the family is known to have some influence on the education of children. Among other things, the income of the family in particular, plays a significant role in determining the socio economic status of the family.

4.3.3.1 Occupation

13(30.2%) were unemployed / had no occupation, 1(2.3%) was a daily wager, 14(32.6%) were in some kind of service while 15 (34.9%) respondents were studying. The major occupations in the area were labour jobs in the nearby town in the fields of construction activity or contract labour in upcoming industries in the nearby zone or agricultural labour. Apart from working as labour, cattle rearing, 4 of the total respondents were self employed, of which 2 did tailoring, 1 had a cycle repair shop and 1 had his own Provision

store. None of the female respondents was doing any outdoor job except for schooling which was also limited to only 3 respondents. Most of the female participants were engaged in household jobs like cleaning floors, washing utensils, clothes, preparing food etc.

Disability though was considered as a negative quality by the society for marriage, so working for house hold jobs was one way to still strengthen the view that they were mobility impaired but not disabled for the household functions. Immobility was narrated as a felt experience by many respondents as lack of employment/occupation had a direct relationship with the family income.

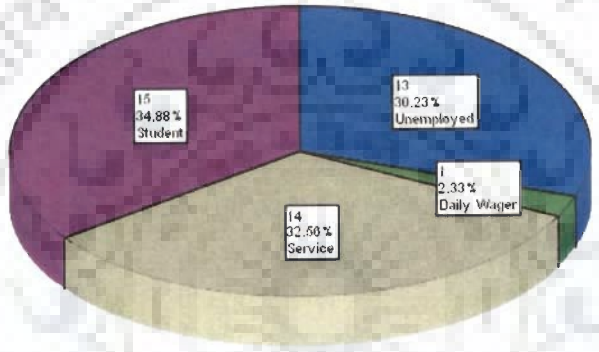


Fig. 4.15 Frequency distribution of respondents based on Occupation types

4.3.3.2 Family Income and People's Perceptions

The distribution of the total sample of respondents is indicated through Table no. 4.5 [Cross tabulation of Age and Family Income].

Household service facilities like electric supply, water supply, toilet facility have a strong dependence on the income status of the family. More than half of the respondents had very low incomes with 7(16.3%) households in the category of less than Rs.1000/- per month and 21(48.8%) respondents in the category of Rs.1000/- to Rs.2000/- per month. Only 5(11.6%) interviewees had income in the range of Rs.2000/- to Rs.3000/- and 7(16.3%) in the income category of greater than Rs.4000/-. 3(7%) participants did not disclose their status of family income. These income groups were distinctly created to have an understanding of the range of incomes. Family income was also affected by the number of members in the household.

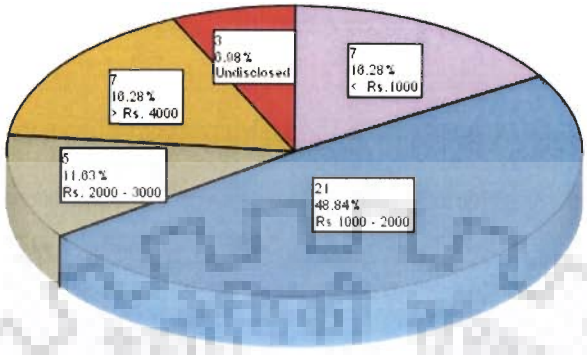


Fig. 4.16 Frequency distribution of respondents based on Family Income

4.3.3.3 Self Perceived Economic Status

In an environment of ever rising prices and high inflation, while it is becoming difficult for a common man to meet both ends, it is heartening to learn from the experiences of the survey participants in response to the question asked, How do you perceive your household economic status? The crosstab analysis presented in Table no. 4.4 shows the respondents perceptions.

Qualitative Responses

Vikas's (respondent no.1) mother told, "We live on debt and there is no saving. All expenses go up in eating/feeding the family only etc. " She highlighted that they were unable to afford Vikas's disability.

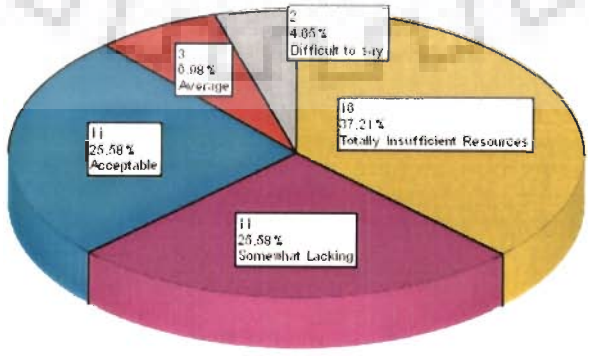


Fig. 4.17 Frequency distribution of respondents based on self perceived Economic status

4.4 DISABILITY PARTICULARS

4.4.1 Disability and its Cause

Fig. 4.4 suggests that a large percentage of respondents 35(81.4%) had Polio. 1(2.3%) out of 43 participants got disabled due to paralysis while 7(16.3%) got mobility impairments due to accidental injury, burns or amputation. It can be observed that Polio is the single largest factor of mobility impairments. It can also be seen that 37(86%) out of 43 cases had the occurrence of disability by birth while 5(11.6%) respondents acquired disability due to an accident and 1 (2.3%) among them due to some prolonged illness. Malnutrition or genetic factors seem to be responsible for poliomyelitis while road accidents and accidents in farms were responsible for injury based disability.

4.4.2 Disability Type

It was also observed that 31 (72.1%) respondents were in the category of ambulant disabled while 12 (27.9%) belonged to the non ambulant category.

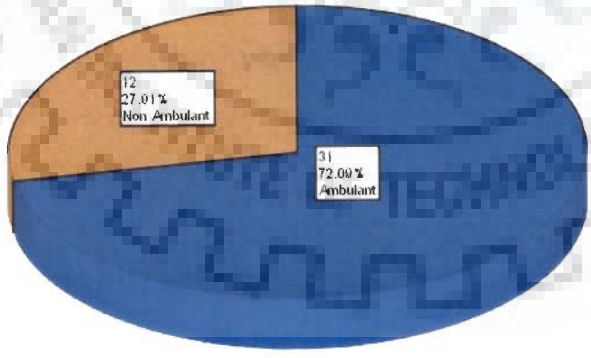


Fig. 4.18 Frequency distribution of respondents based on Disability Type

4.4.3 Degree of Mobility

Since, there was no direct measurement tool to quantify their degree of mobility, a 5 point scale with the following divisions was used for knowing the degree of mobility of various participants in the villages. Degree of disability was measured on the basis of their extent of mobility in their environment. Fig. 5.19 shows the distribution of participants based on their degree of mobility.

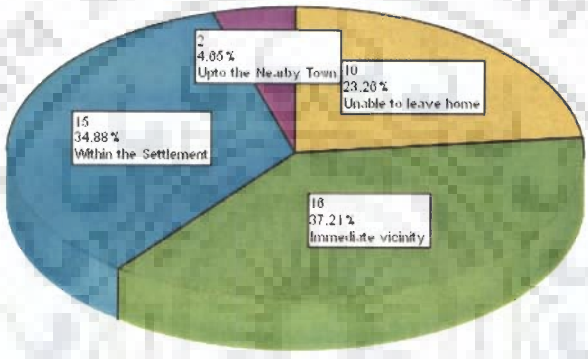


Fig. 4.19 Frequency distribution of respondents based on Degree of mobility

4.4.4 Mobility Devices

Mobility for the mobility impaired is being facilitated through either mobility devices (viz. stick, crutches, wheeling devices like the wheelchair, tricycle or self created ground mobility devices) or in the form of human assistance. 28 (65.1%) respondents had no mobility device, 7(16.3%) used walking stick/cane for mobility assistance while 4 (9.3%) respondents used crutches to aid their movement. 2 (4.7%) respondents had tricycle for their mobility needs and 1 (2.3%) each case possessed a wheelchair and an indigenously created ground mobility device. Looking at the above figures, it clearly indicates that wheelchair was a very unpopular mobility device in these cases with locomotor disabilities. The possible reasons for it's not being a commonly used mobility device were :

1. Cost and Affordability
2. Working height
3. Mobility on the rural terrain
4. Thresholds as barriers – The problem of transfer
5. Sources of availability
6. Issue of Maintenance

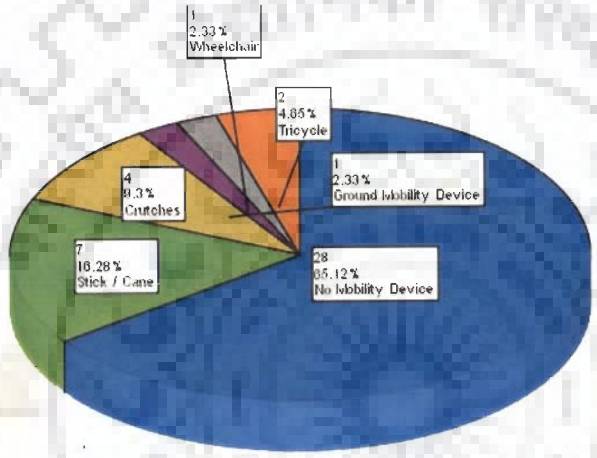


Fig. 4.20 Frequency distribution of respondents based on Mobility device

Wheelchair

Wheelchair use as a mobility device was rarely sighted in only one home where the participant's family members had bought a second hand wheelchair for facilitating better movement within the home. This was perhaps possible because this participant's house also had a terrazzo flooring which is hard and smooth. However, in most of the cases an open courtyard with mud flooring and a level up verandah with a threshold barriers in the room were insurmountable by a wheelchair. Also, crossing the house threshold (of almost 1'-0" to 2'-0") with a drain in front of it were considered as barriers too high for a wheelchair to traverse. The most critical factor being that most activities in the rural context were confined to low or ground levels, which would make wheelchair a misfit for working on those heights.

Tricycles

Tricycles are designed for use externally and have three large bicycle wheels, supposedly making them more suited to use on surfaced roads and better for long distances. However the tricycles observed were unwieldy and cumbersome when used on smaller roads, and they have large turning radius. This prevents them being used in confined spaces, such as the narrow street lanes in the village settlement. They were also found to actually be difficult to use on un-surfaced and uneven roads, particularly as there is very limited amount of power achievable by hand-cranking the machine compared to a traditional peddle bicycle or a self propelled wheelchair that had two large rear wheels. The use of these tricycles for reducing mobility barriers (for non ambulant participants) seems therefore somewhat limited.

One respondent (Meera Devi, her name) told that she was being offered a tricycle as an assistive device, but she refused to take it, thinking what would people say? She told that she generally stays all the time at home and is not so comfortable moving out alone, as male members of the community would pass remarks.

Respondents response to mobility devices has been summarized as follows:

"He had a walking stick but he has stopped using it as it pains in his under arms."(Vikas) He is scared of using an assistive device.

Raj Kumar(respondent no.2) in his response stated, " I personally bought a wheelchair for Rs. 2500/-. I got the ground level mobility device with a plank and bearings made at home. Another motorised Tricycle, was purchased by my father which costed around Rs.20,000/-."

Azad's (3) parents responded that " We had got him calipers. But he used to cry a lot as they were either misfit or he was not able to carry them to walk."

Pankaj's (Neetu, 4) response was, "I do feel the need of a walking support device, but what to do, I can neither afford on my own nor do I have any source in the Government administration who could get me one. "

Pradeep's (respondent no. 23) father reported that, "He did wear calipers but other children at school made fun of him. He felt that and ever since he doesn't wear it. Also couldn't get the right shoe for him. It breaks. He uses walking stick. He used to get late for school, for the English class. That's how he learnt cycle." Pradeep added to it ". If I would wear calipers then I would not be able to ride bicycle."

Deepak's (respondent no. 26) family members told that "He fears using any other assistive device. So we have created this device with which he is able to balance himself and walk in the house."

Sagar's (respondent no. 28) mother told that, "He used calipers as an assistive device(which are now broken). " She also told that she could not find any possibility of getting them repaired in their village. Also, during summers Sagar had major problem wearing them.

Fig. 4.21 Ram Kishore walking to toilet using walking stick.

Fig. 4.22 Sushma crossing drain using walking stick.

Fig. 4.23 Shahzadi using Aluminium crutches as a mobility device.

Fig. 4.24 Sonia crawls to move on the pathway in the absence of a mobility device.

Fig. 4.25 Raj Kumar using wheelchair for mobility in his house.

Fig. 4.26 Israr being assisted by a family member to move.

Fig. 4.27 Pappu rides on his tricycle

Fig. 4.28 Deepak using an indigenously created mobility device.

Fig. 4.29 Callipers as a prosthetic device.

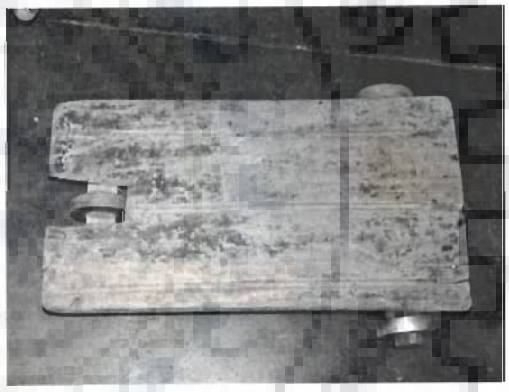


Fig. 4.30 Indigenously created Ground mobility device by a respondent.

Fig. 4.31 Indigenously created wooden mobility device by a respondent.

4.5 POSTURAL LIMITATIONS

During the interview an attempt was made to understand their postures of comfort with respect to the common postures adopted for daily activities. The participants were asked to rate the degree of comfort in the following body postures which they normally have to use sometimes or the other in the performance of ADLs. This allowed the researcher to gain insight into their postural limitations.

4.5.1 Standing

Fig 4.32 suggests that 16(37%) participants found very difficult to stand while 20(46.5%) respondents rated it as difficult. 7(16%) respondents rated their perception as neither difficult nor easy. Further, the crosstab analysis (Table 4.6) of rating of their postural experience with respect to their type of disability reveals, all non ambulant disabled rated their experience of standing as very difficult while only 4 amongst the ambulant disabled felt it as very difficult to stand. The rest 20, who also experienced some kind of difficulty in standing belonged to the ambulant category. Also, the ones (7 participants) who felt neither difficult, nor easy to stand also belonged to the ambulant category.

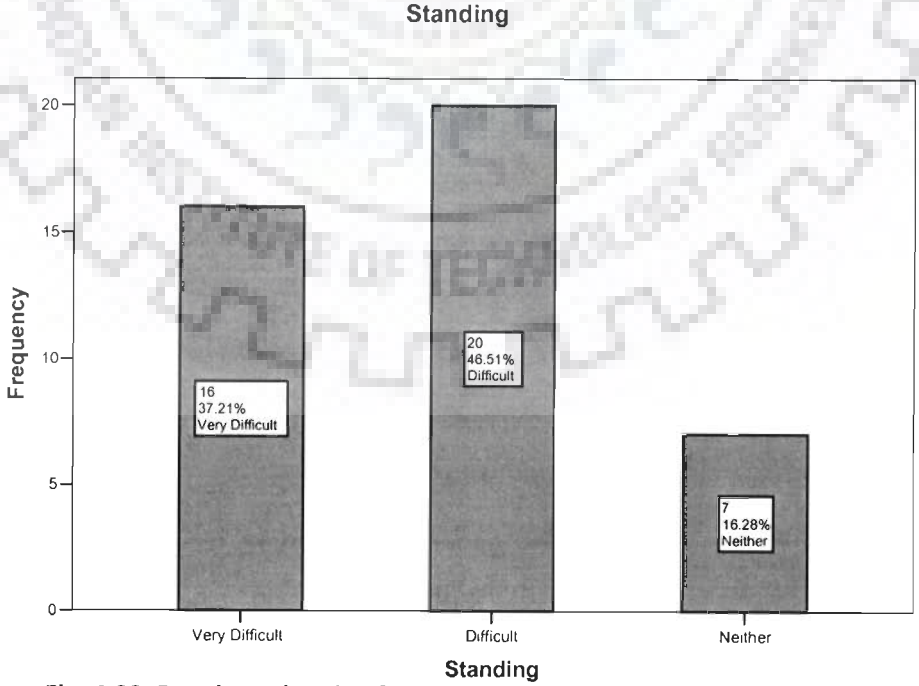


Fig. 4.32 Bar chart showing frequency distribution of degree of difficulty in Standing posture by survey respondents.

Table No. 4.6 Disability Type * Standing Crosstabulation

			Standing			
			Very Difficult	Difficult	Neither	Total
Disability Type	Ambulant	Count	4	20	7	31
		% of Total	9.3%	46.5%	16.3%	72.1%
	Non Ambulant	Count	12	0	0	12
		% of Total	27.9%	.0%	.0%	27.9%
Total		Count	16	20	7	43
		% of Total	37.2%	46.5%	16.3%	100.0%

Standing as a posture was a basic requirement for mobility. For the ones who were non ambulant, the common ways of mobility were crawling, squat walk or wheeling devices as an aid provided them mobility. In the absence of mobility devices, human assistance in the form of care givers came to their rescue.

4.5.2 Squatting

Squatting forms one of the very common postures of rural daily living, since most of the activities are concentrated at ground level. Unlike urban areas where most work happens at waist level, squatting to perform several daily chores is a common form. The Indian style of seating in the context of toileting also refers to the squatting posture. Fig. 4.33 refers to the frequency distribution of the perception of the respondents about the degree of difficulty in adapting that posture. It is striking to note that quite a significant number of respondents 16 (37.2%) rated their experience as very difficult. It is also noted that 23 (53%) of the participants rated it as difficult while 4 respondents expressed squatting as neither difficult nor easy. Table 4.7 presents a crosstab analysis between the type of disability and the respondent's perception about squatting. It reveals that amongst the non ambulant participants, 6(14%) found it very difficult to squat, 5 (12%) of them found it difficult while 1 (2%) of the non ambulant respondents found it neither difficult nor easy. It is interesting to note here that though all the non ambulant participants found it very difficult to stand, the distribution of their perceptions for

squatting is evenly spread. While in the case of ambulant disabled people, 10 (23%) found it very difficult, 18 (42%) found it difficult to squat while 3 (7%) rated their experience as neither difficult nor easy.

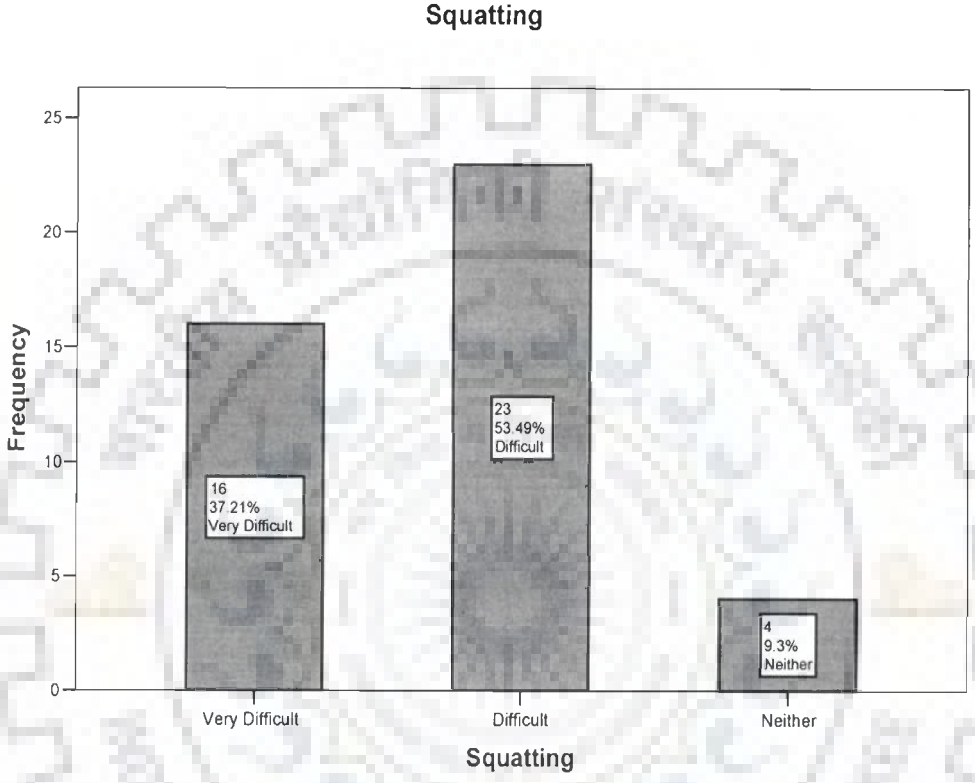


Fig. 4.33 Bar chart showing frequency distribution of degree of difficulty in Squatting posture by survey respondents.

Table 4.7 Disability Type * Squatting Crosstabulation

			Squatting			
			Very Difficult	Difficult	Neither	Total
Disability Type	Ambulant	Count	10	18	3	31
		% of Total	23.3%	41.9%	7.0%	72.1%
	Non Ambulant	Count	6	5	1	12
		% of Total	14.0%	11.6%	2.3%	27.9%
Total		Count	16	23	4	43
		% of Total	37.2%	53.5%	9.3%	100.0%

4.5.3 Sitting cross legged

Response of survey participants was also taken for cross legged sitting posture. It was found through Fig.4.34, that only 5 (12%) people found it very difficult to sit in crosslegged posture while 11 (25.5%) found it difficult and 19(44%) of them found it nether difficult nor easy to sit in crosslegged posture. 8(18.6%) participants found it easy to sit in cross legged posture. Further, Table 4.8 shows that amongst the non ambulant category participants, only 1(2%) found it very difficult to sit in cross legged posture, owing to the problem of folding leg, while 7 (16%) of them rated their experience as difficult and 4(9%) as neither difficult, nor easy. The distribution of perceptual ratings amongst ambulant disabled was such that 4 (9%) each rated it as very difficult and difficult to sit crosslegged. However, 15(35%) and 8 (19%) of them rated it as an easy posture to maintain.

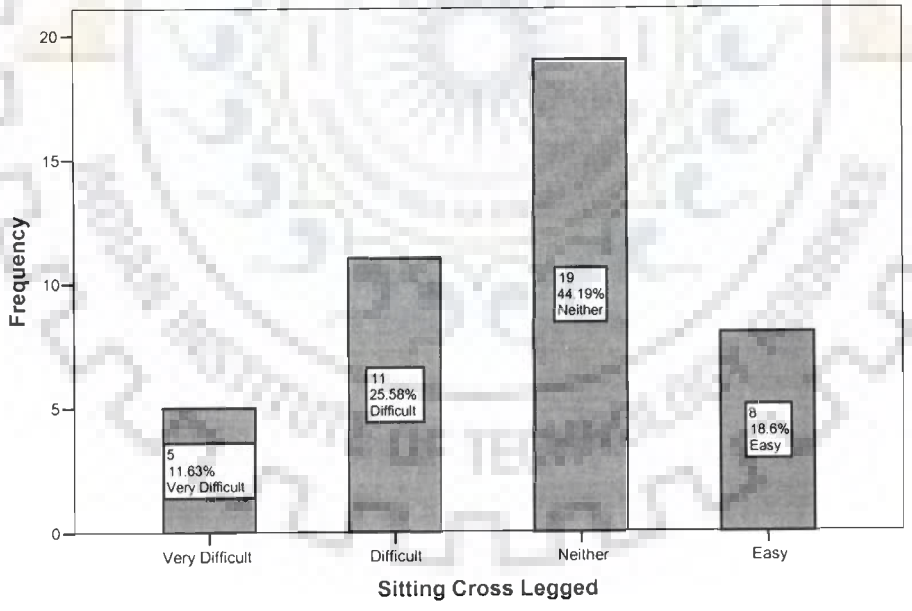


Fig. 4.34 Bar chart showing frequency distribution of degree of difficulty in Sitting Cross Legged posture by survey respondents.

Table 4.8 Disability Type * Sitting Cross Legged Crosstabulation

			Sitting Cross Legged				
			Very Difficult	Difficult	Neither	Easy	Total
Disability Type	Ambulant	Count	4	4	15	8	31
		% of Total	9.3%	9.3%	34.9%	18.6%	72.1%
	Non Ambulant	Count	1	7	4	0	12
		% of Total	2.3%	16.3%	9.3%	.0%	27.9%
Total		Count	5	11	19	8	43
		% of Total	11.6%	25.6%	44.2%	18.6%	100.0%

4.5.4 Bending

Bending, usually an intermediate posture to reach ground while turning one's back was most commonly observed in women performing household chores like brooming etc It required to bend to sweep the floors usually as a practice by the able bodied people. However, owing to personal limitations, for people with mobility impairments, it became a tedious posture to maintain. Fig. 4.35 shows that 8(18.6%) of the participants found it very difficult to bend while 18 (42%) found it difficult and 13 (30%) rated it as neither easy nor difficult to bend while 4(9.3%) persons rated their experience as easy.

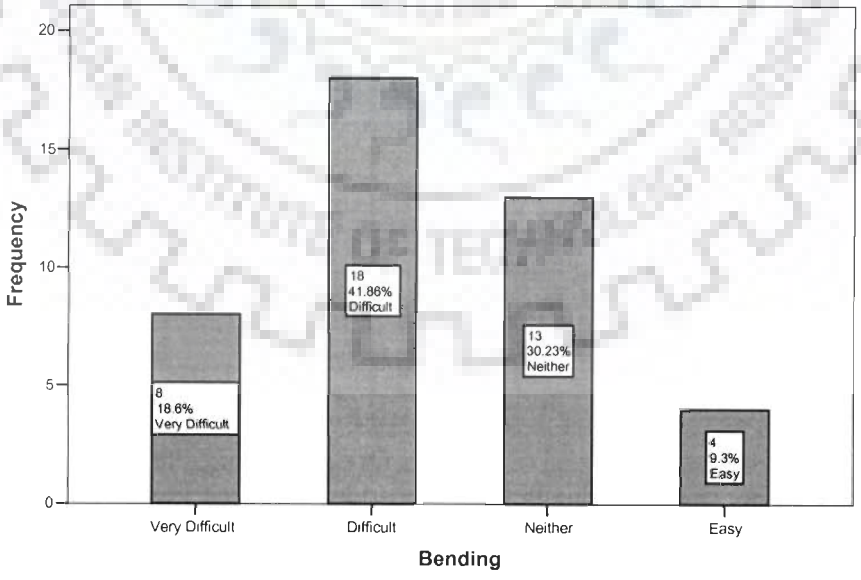


Fig. 4.35 Bar chart showing frequency distribution of degree of difficulty in Bending posture by survey respondents.

Table 4.9 shows that bending was a difficult posture to maintain for 4(9.3%) each in the category of ambulant and non ambulant disabled.

Table 4.9 Disability Type * Bending Crosstabulation

			Bending				Total
			Very Difficult	Difficult	Neither	Easy	
Disability Type	Ambulant	Count	4	12	12	3	31
		% of Total	9.3%	27.9%	27.9%	7.0%	72.1%
	Non Ambulant	Count	4	6	1	1	12
		% of Total	9.3%	14.0%	2.3%	2.3%	27.9%
Total		Count	8	18	13	4	43
		% of Total	18.6%	41.9%	30.2%	9.3%	100.0%

Though it would be very difficult to generalize the interrelationships between postural limitations, but it could be easily made out that a limitation in a particular posture led to some or the other difficulty in performing an activity. For eg. One who finds difficult to squat, would also generally find difficult to defecate in on an Indian WC. Similarly, difficulty in standing led to difficulty in mobility too. However, people's perceptions also were an outcome of their adaptability to a particular posture which may depend on their degree of disability and the number of years since they acquired it.

4.6 REHABILITATION PARTICULARS

Rehabilitation as defined in the literature review deals with the overall development of the person with disability. It aims at using his potential to the greatest extent so that he could attain some degree of independence. Rural environments, however experience a different kind of rehabilitation process, as they are at the grass root levels of existence.

4.6.1 Rehabilitation status

Fig. 4.27 shows the rehabilitation status of the survey respondents. It shows that only 6(14%) participants had received Government based rehabilitation while the rest 37

(86%) did not receive any form of Rehabilitation support from the Government. Several factors came up during discussions to explain this :

1. Awareness – Most respondents were not aware of how to initiate the process and did not have enough means to get so.
2. Bureaucratic Administration
3. Gaps in Needs Assessments – Few respondents told that they were offered some kind of assistive device which they felt they did not need.
4. Lack of Infrastructure to support Vocational Rehabilitation

Fig. 4.36 Frequency distribution of respondents based on their response on whether any form of Rehabilitation was received by them

4.6.2 Rehabilitation Preferences

The last question of the Section I of the survey schedule was about knowing their rehabilitation preferences . The following were the available choices as summarized –

a.) Medical Support

b.) Assistive Technology

c.) Environmental Design Support

d.) Vocational Rehabilitation

e.) Social Attitudinal Support

Fig. 4.37 to Fig. 4.41 shows the degree of rehabilitation preferences as indicated by the respondents.

For the medical support, 8(18%) respondents felt a very high need for it while 7(16%) participants expressed a high opinion. However, it was worth nothing that majority of respondents did not give it a very high priority for rehabilitation with 6(14%) giving a medium response, 8 (18%) keeping it as a low priority while 14(32.5%) rated it as very low preference. This was felt majorly because all the respondents had a permanent disability and had already tried their level best for possible medical corrections even much beyond their affordable ranges. Also, it was realized that medical based support is generally expensive and required them to move from their village to bigger towns for their treatment.

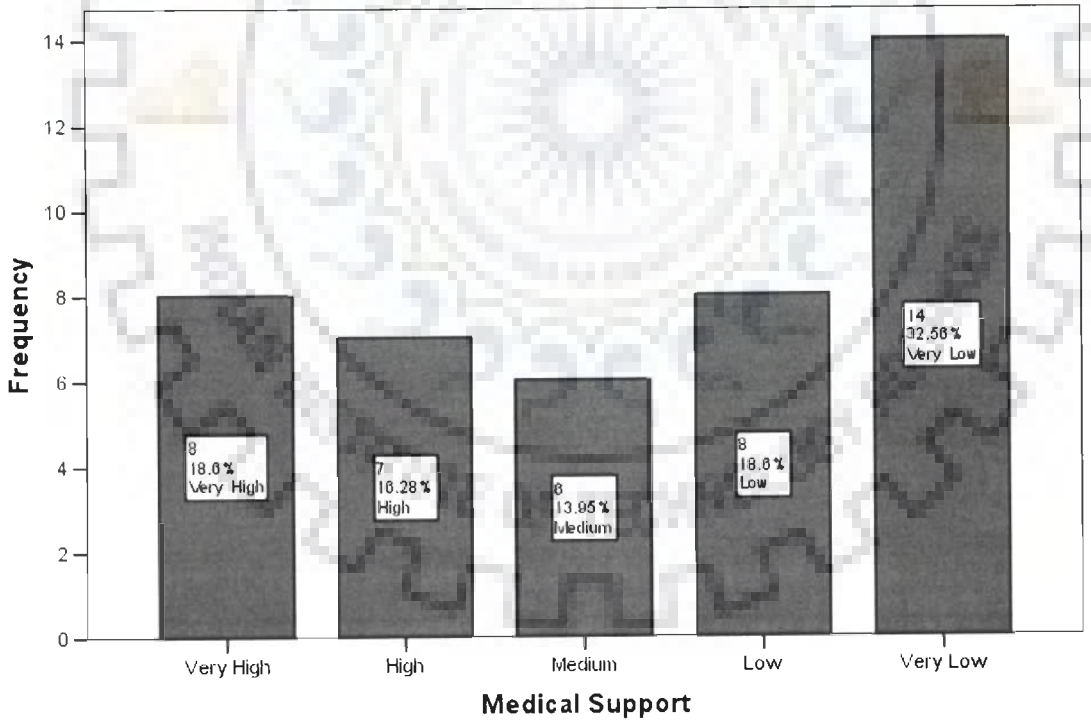


Fig. 4.37 Bar chart showing frequency distribution of respondent's degree of preferences for rehabilitation through medical support

While trying to gather the response of the mobility impaired participants for the environmental design interventions for their rehabilitation, it was found that 5(12%) respondents felt that changes in their environment would be very highly beneficial while 7(16%) expressed their opinion as high. While majority of the respondents, 16(37%) expressed medium degree of preference for environmental design based interventions. They were honest in their expressions by informing the researcher that they had never though much in this direction, since disability to them was more of a medical phenomena, all efforts were concentrated upon the person with mobility impairments rather than on the environment around it. However, in the light of development of enablement theories and understanding of the disablement process, environmental factors are now understood as a significant player in disabling or enabling one's experience.

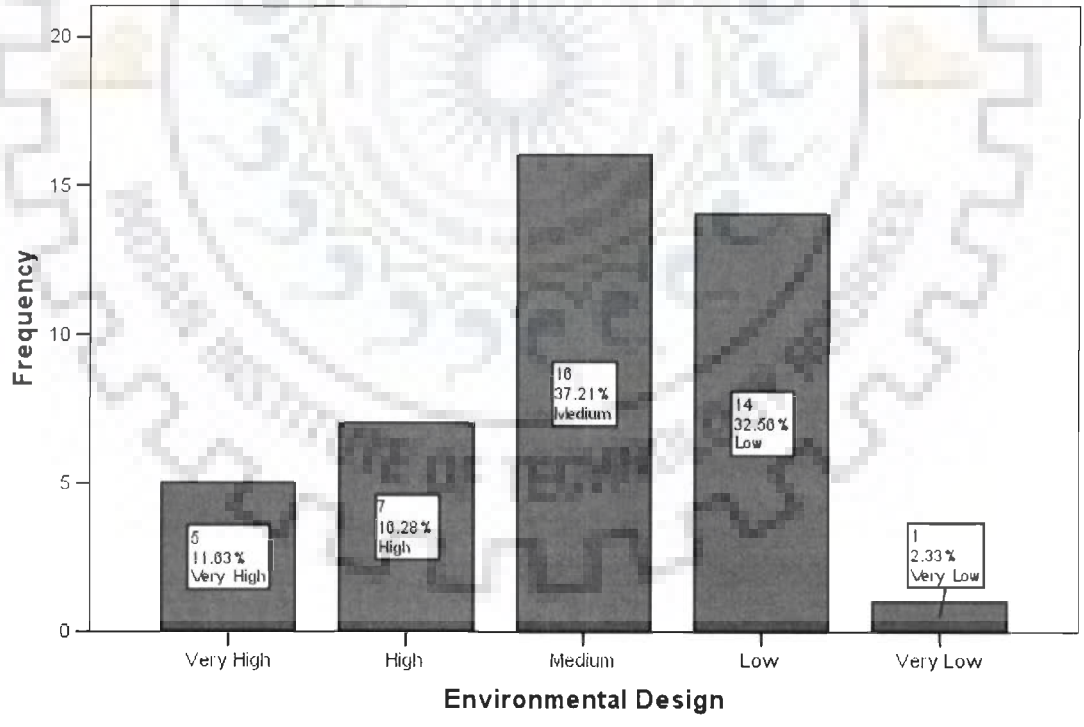


Fig. 4.38 Bar chart showing frequency distribution of respondent's degree of preferences for rehabilitation through Environmental design.

Fig. 4.39 suggests the preferences as rated by the mobility impaired participants for Vocational support. It was important to note that it gathered highest preference of 16(37%) participants suggesting a very high need for vocational rehabilitation while 9(21%) rating their response as high degree of preference. 11(25.5%) participants rated their preference as medium while 5 (12%) of the respondents rating their preference as low. Rural environments have a common trend of every adult (or even yound adult) member of the family contributing in some way to the family's economy. Having one or the other vocation was thus considered very important to earn one's livelihood and thus be economically independent. The genuine concern of the family members of the survey respondents was that if the disabled family member is able to eke out some way of livelihood at home. Thus, they showed high interest in learning some trade like tailoring, etc. which could bring some hope to them. Though, no vocational rehabilitation centre was found in any village.

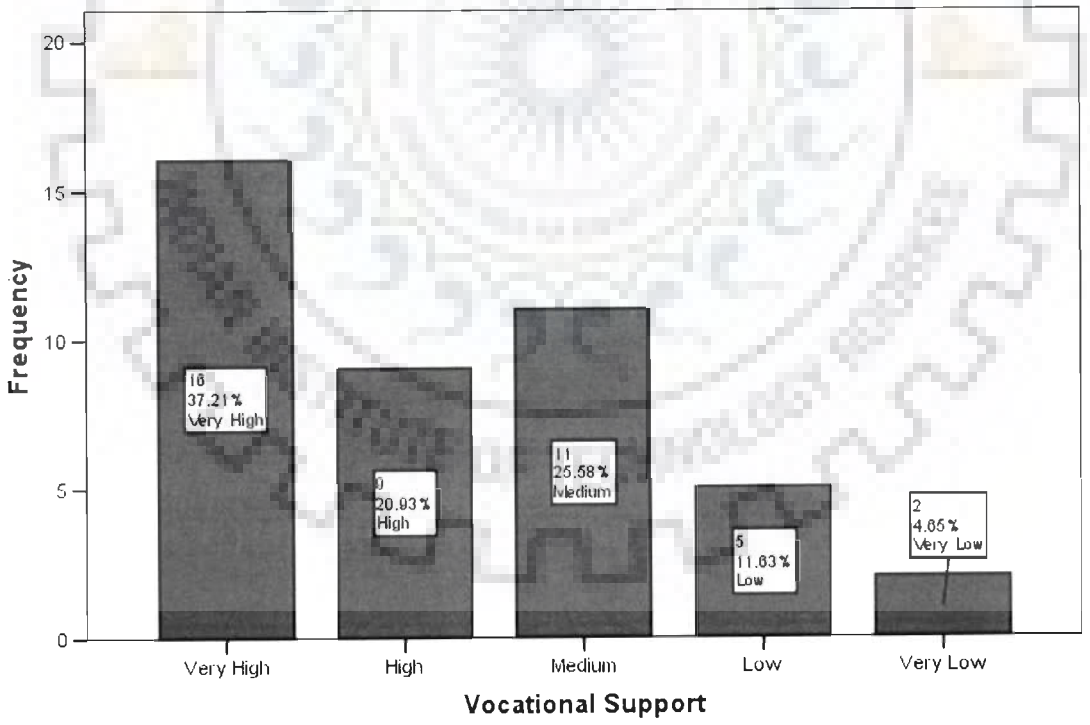


Fig. 4.39 Bar chart showing frequency distribution of respondent's degree of preferences for rehabilitation through Vocational support

The survey participants generally expressed some degree of awareness about the Government level schemes for giving some form of economic benefits to the people with disabilities. However, most of them said, they never had received it, as they were not aware, where and how would they get it. Also, not many of them had their disability certificates, without which no government aid would not be admissible to them. Nevertheless, when asked as a preference of rehabilitation, a very large number of respondents expressed their response as very high and high preference for rehabilitation . The ones who placed economic benefits as a low and very low preference, did not have much hopes of economic benefits from a Governmental system owing to its tedious process and thus lost interest in it.

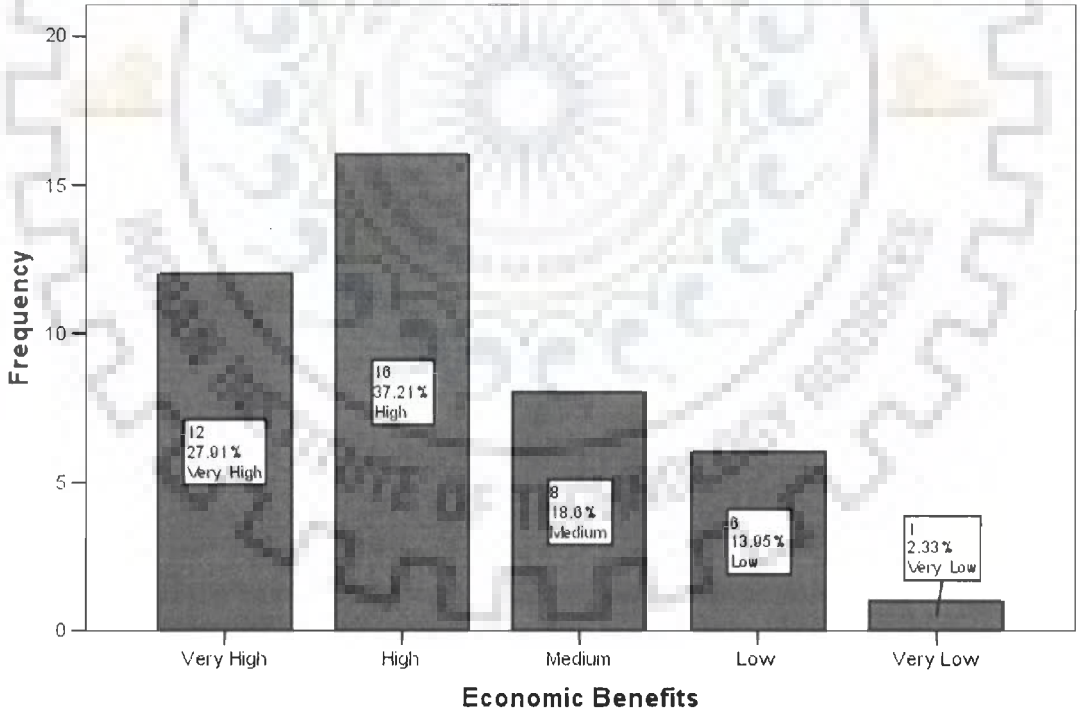


Fig. 4.40 Bar chart showing frequency distribution of respondent's degree of preferences for rehabilitation through direct Economic benefits.

The last amongst the rehabilitation preferences was the aspect of social and attitudinal support. It was interesting to note that more than half of the respondents (25 i.e. 58%) expressed it as a very low preference. This was possibly due to two reasons, either they had a very good social support or they were not able to value its understanding. However, it was found in almost all respondents environment that they received good care and social attention from family members and friends. Also a rural system being too informal with large families, social mixing was generally observed to be generally good.

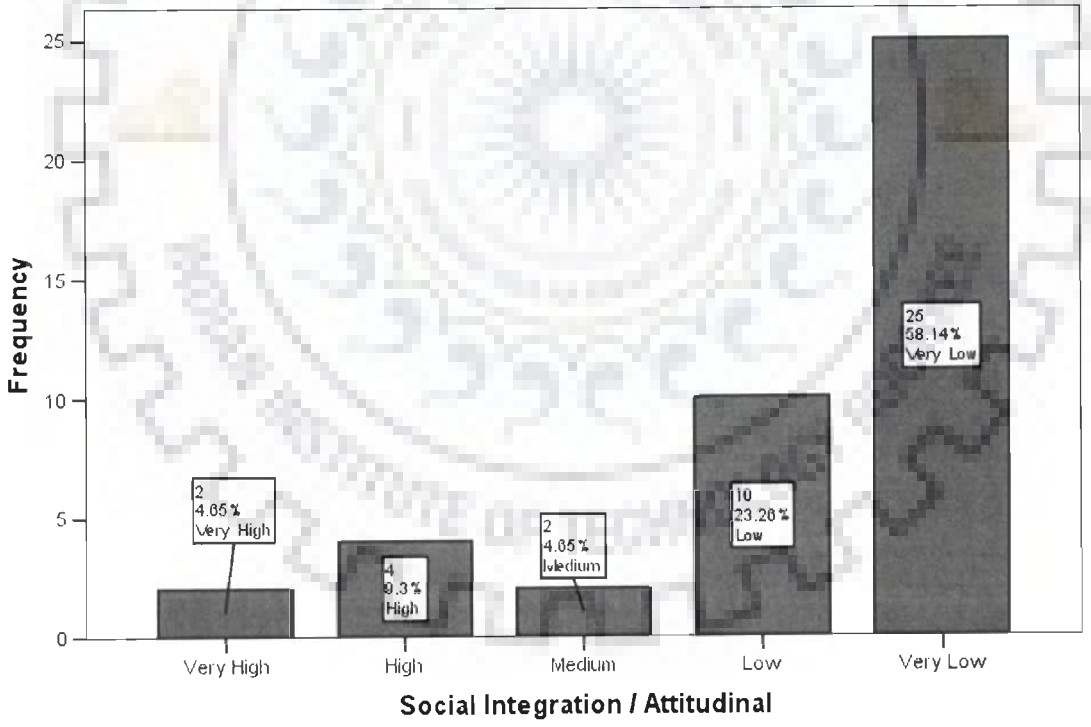


Fig. 4.41. Bar chart showing frequency distribution of respondent's degree of preferences for rehabilitation through Social support

4.7 CONCLUSIONS

In this chapter the results of the survey relating to the socio demographic, socio economic aspects, disability based parameters and rehabilitation issues were reported and discussed with some qualitative views of respondents. Following are the key findings :

1. Persons with mobility impairments are generally from low economic status. The household heads are mainly involved in labour work as the prime occupation.
2. Disability further impairs the economic activity of the individuals. It supports the earlier theory of Disability is a cause and consequence of poverty.
3. Marital status of the persons with mobility impairments, particularly in the non ambulant category was considered a social taboo. So none of the non ambulant samples were married.
4. Disability certificate is an important document to receive any form of Government aid and many participants did not have one. The main reasons for that was their awareness, ignorance and lack of knowledge about whom to approach for that certificate.
5. Most of the participants had no mobility device due to either wrong assessment or identification.
6. Wheelchairs were not so popular among the mobility impaired participants in the rural environments due to its usability with the rural uneven terrains and also because the work level was mostly at ground.
7. There were some indigenous innovations at people's level wherein they had themselves produced some assistive devices.
8. Postural Limitations had some affect on the mobility impairments. However, cross legged seating was found to be the most easily adapted posture by many respondents.
9. Rehabilitation preferences were discussed among the survey participants. Though, it was difficult for them to prioritize, vocational training formed a concurrent view of most participants so as to add to some degree of economic independence.

Chapter 5

ACTIVITIES OF DAILY LIVING

5.1 INTRODUCTION

From the socio demographic aspects as discussed in Chapter 4, the study extended to gain further insight into the Activities of Daily Living (ADLs) as performend by the survey participants. This was facilitated through Section II of the interview schedule which followed a semi structured format in its administration. The participants were also asked to rate their perception of difficulty in performing those ADLs on a unipolar five point scale [operationalized as Perceptual Experience Rating (PER)]. In addition to the verbal discussions, the respondents simulated the activities of self care (fetching water, toileting and bathing) as they would normally perform in their daily routines. The simulation of ADLs done by the participants was photo documented, of which specific case studies are selected for discussion in this chapter. This led to the observation of certain barriers and facilitators as an interaction between the respondents and their immediate environments. It was spontaneous for the family members and other community members to be contributing to the discussions both before and after the simulation which validated the data collection process. This chapter, thus brings to light a detailed account of ADLs analysis studied under this research framework in the following sequence :

1. Mobility related Activities
2. Transfer Activities
3. Self care Activities
    a. Fetching Water b. Toileting c. Bathing

4. Occupational Activities

   a. Education b. Household work c. Employment activity

5. Social Participation Activities

   a. Leisure activities b. Family networks c. Community decision making

   d. Health related participation e. Religious Participation

5.2 MOBILITY RELATED ACTIVITIES

Mobility is critical for one's daily tasks of diverse activities. It was observed through the survey that degree of mobility had a direct impact on the level of ease, reach, access and use of space to perform diversity of ADLs. The participants were asked to rate their perceptions [PER] on a unipolar 5 point scale (Mulholland, S J et al, 2002) as a two stage process. Movement was required as an independent and an intermediate activity for other ADLs. For example, an individual requires to move in order to reach the space where ADL (like toileting, bathing etc) has to be performed.

5.2.1 Walking Short Distances

Horizontal movement referring to the ground level mobility was found to be the most common form of movement by the survey participants irrespective of their type and degree of disability. Moving for leisure in and outside the home or mobility to fetch water for household works in addition to self care activities (like going to open fields for toileting) were the common sights of observation with the participants. For the one's who were ambulant disabled, used to limp, bend, or use another hand over their leg to aid walking while the others would use walking aids like stick or crutches as the most common form of mobility devices. The non ambulant participants also were able to move

short distances (ranging from 20 to 100 feet) by crawling or in a squatting posture. However, some of them used wheeling mobility devices for movement.

Pain and imbalance were reported as common personal limitations to mobility. Lack of mobility device and gender based problems were also reported as factors limiting the extent of movement for some of the participants. The participants were then asked to rate their perception of degree of difficulty in horizontal movements for short and long distances. Short distances referred to moving within the home and beyond upto the neighborhood. Fig. 5.1 shows the bar chart describing the PER scores as reported by the respondents. It clearly shows that 8 (18%) participants experienced walking short distances as very difficult. 13 (30%) participants rated it as difficult while 17(40%) respondents felt it as neither difficult nor easy to walk short distances. Only 5 (11%) participants felt that it was easy for them to cover short distances.

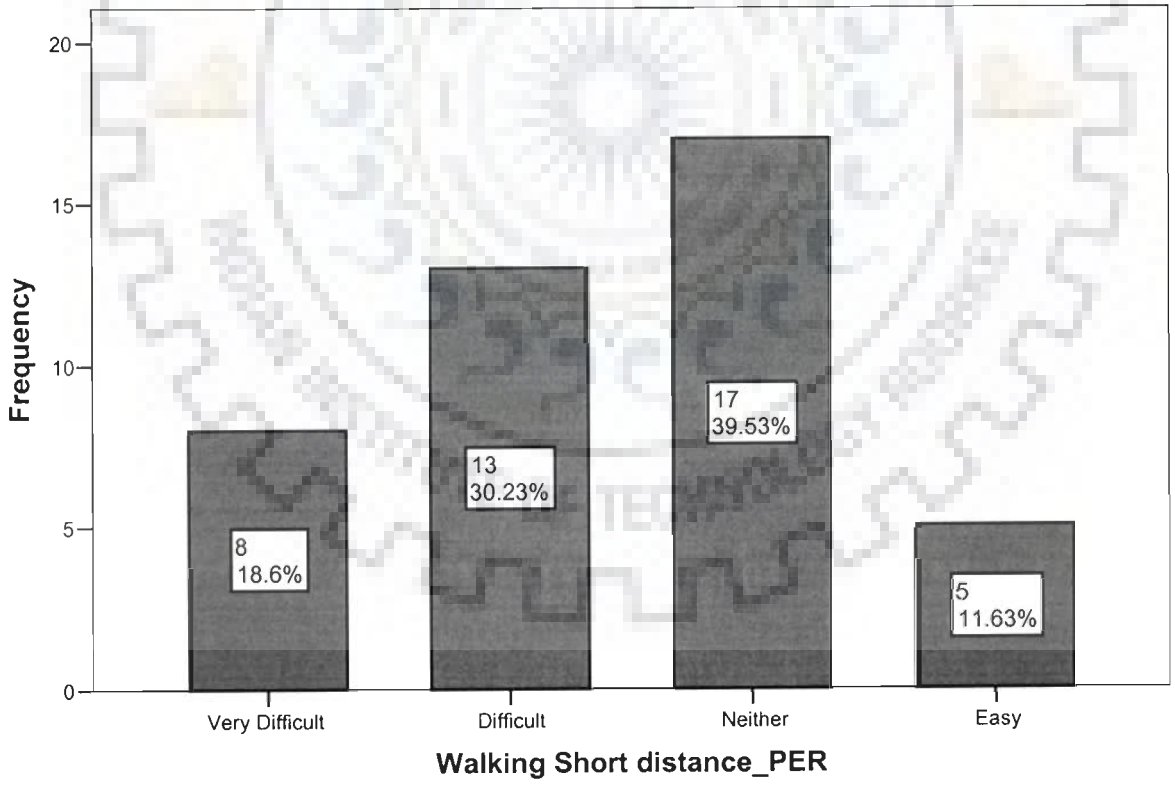


Fig. 5.1 Bar chart showing frequency distribution of degree of difficulty in walking short distances by survey respondents.

Table 5.1 shows the crosstab analysis between the disability type and the perceptual experience rating by respondents for walking short distances. It clearly shows that the non ambulant survey participants had a great difficulty in mobility for even short distances with seven participants responding their PER as very difficult and five responding it as difficult. However, in contrast to this, only one participant in the ambulant disabled category had a rating of moving short distances as very difficult, while eight responded as moderately difficult. Seventeen persons from the ambulant category rated their perceptions for mobility as neither difficult nor easy while five persons found it easy to walk short distances.

Table 5.1 Disability Type * Walking Short distance_PER Crosstabulation

			Walking Short distance_PER				
			Very Difficult	Difficult	Neither	Easy	Total
Disability Type	Ambulant	Count	1	8	17	5	31
		% of Total	2.3%	18.6%	39.5%	11.6%	72.1%
	Non Ambulant	Count	7	5	0	0	12
		% of Total	16.3%	11.6%	.0%	.0%	27.9%
Total		Count	8	13	17	5	43
		% of Total	18.6%	30.2%	39.5%	11.6%	100.0%

The crosstab analysis in Table 5.2 shows that amongst 8 participants who had great difficulty in walking short distances, 5 had no mobility device, while 1 respondent had wheelchair and 2 possessed a tricycle as an assistive device. Also, it was found that wheelchair and tricycle were owned by non ambulant category participants as mobility devices. However, it was realized that wheelchair was quite difficult to manoeuvre for short distances in the house or within the neighborhood owing to barriers like thresholds, narrow doorways, open drains etc. Also, since most of the ADLs were performed on ground level, a wheelchair was found unfit to aid the ADL performance as transferring on and off it was still a cumbersome activity. Tricycle was completely unfit for inside home settings as it is designed to travel relatively long distances. The crosstab also shows that 10 persons, who did not possess any mobility device also experienced mobility as a difficult activity while 11 persons with no mobility device rated it as neither difficult nor

easy. 2 participants with no mobility device rated their mobility experience as easy. Out of 7 participants who possessed a walking stick as a mobility device only 1 found it as difficult to walk short distances while 3 participants each rated their experience as neither difficult nor easy and easy respectively.

Table 5.2 Mobility Device * Walking Short distance_PER Crosstabulation

			Walking Short distance_PER				
			Very Difficult	Difficult	Neither	Easy	Total
Mobility Device	No Mobility Device	Count	5	10	11	2	28
		% of Total	11.6%	23.3%	25.6%	4.7%	65.1%
	Stick / Cane	Count	0	1	3	3	7
		% of Total	.0%	2.3%	7.0%	7.0%	16.3%
	Crutches	Count	0	1	3	0	4
		% of Total	.0%	2.3%	7.0%	.0%	9.3%
	Ground Mobility Device	Count	0	1	0	0	1
		% of Total	.0%	2.3%	.0%	.0%	2.3%
	Wheelchair	Count	1	0	0	0	1
		% of Total	2.3%	.0%	.0%	.0%	2.3%
	Tricycle	Count	2	0	0	0	2
		% of Total	4.7%	.0%	.0%	.0%	4.7%
Total		Count	8	13	17	5	43
		% of Total	18.6%	30.2%	39.5%	11.6%	100.0%

5.2.2 Walking Long Distances

Moving long distances was considered a normal activity for the rural folk who used to walk to the extent of 5 kilometers in a day either to their agricultural farms or place of work in the nearby town etc. Others would walk upto the main road connecting the village to take a vehicular conveyance for moving longer distances. While some of the village people used bicycle for commuting large distances. However, the above choices were not valid for people with mobility impairments, who had to commute long distances either to go to school (for education) or to the place of work (e.g. to work as a tailor in a shop in Roorkee town). Also, it was observed in the study area that moving long distances for mobility impaired participants was a very tedious job. Persistent pain, imbalance and fatigue also added to their personal limitations.

Fig. 5.2 shows the bar chart describing the PER scores as reported by the respondents. It clearly indicates that walking long distances was a problem for almost all mobility impaired participants which shows a significant difference of rating when compared with scores for short distance mobility. 29 participants (67%) reported walking long distances as very difficult while 13 (30%) respondents rated their perceptions as difficult and only 1 participant expressed his rating as neither difficult nor easy.

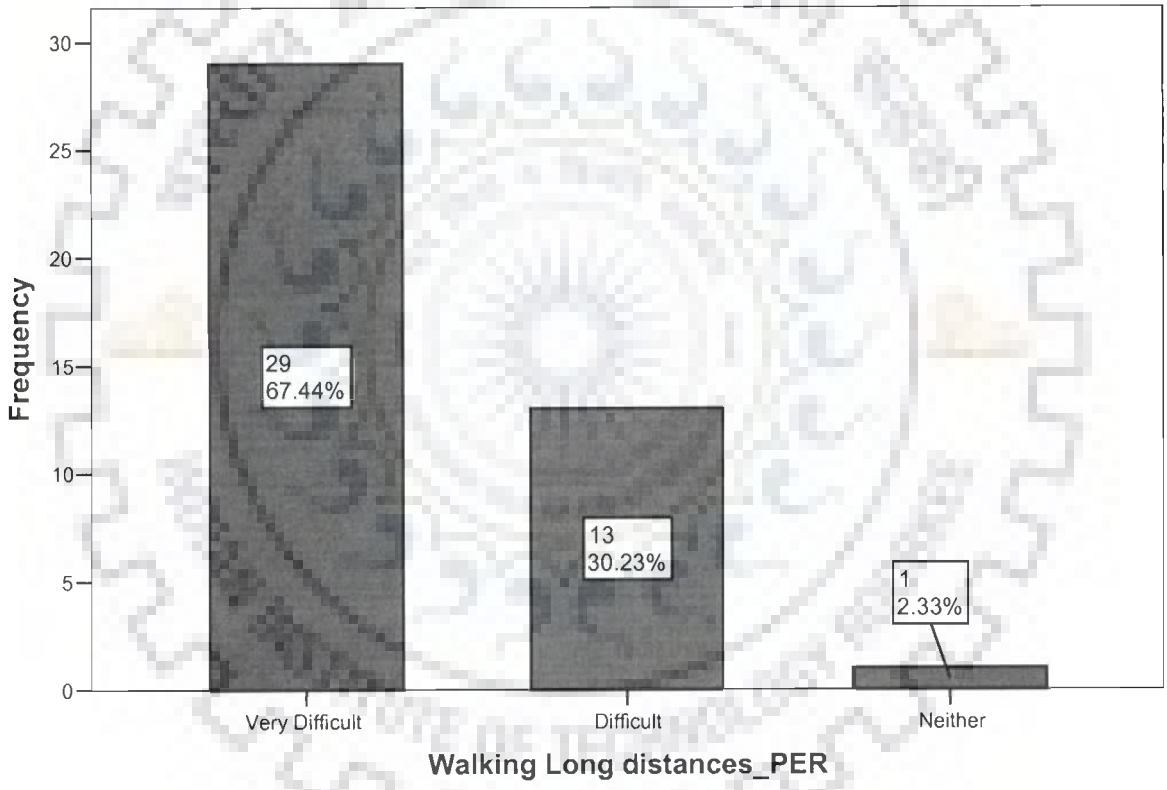


Fig. 5.2 Bar chart showing frequency distribution of degree of difficulty in walking short distances by survey respondents.

Table 5.3 shows the crosstab analysis between type of disability and PER of walking long distances. It reflects the fact that it was very difficult for all non ambulant participants to move long distances with all 12 of them rating their perceptual experience as very difficult (11 rated very difficulty while 1 rated difficult). Also, most of the respondents in the ambulant category also found it difficult to walk for long distances with 17 of them rating their experience as very difficult and 13 among them rating it as difficult. Only 1 participant amongst the ambulant disabled category rated his experience as neither difficult nor easy. The difference in their perceptions could be due to their differences in degrees of disability or their own personal health.

Table 5.3 Disability Type * Walking Long distances_PER Crosstabulation

			Walking Long distances PER			
			Very Difficult	Difficult	Neither	Total
Disability Type	Ambulant	Count	17	13	1	31
		% of Total	39.5%	30.2%	2.3%	72.1%
	Non Ambulant	Count	11	1	0	12
		% of Total	25.6%	2.3%	.0%	27.9%
Total		Count	28	14	1	43
		% of Total	65.1%	32.6%	2.3%	100.0%

The crosstab analysis in Table 5.4 shows that amongst participants with no mobility device 19 (44%) rated their experience as very difficult while 9 (21%) of them perceived moving long distances as difficult. Walking Stick / Cane and crutch users also found it difficult to walk long distances as they used to get tired. Amongst the wheeling device users, almost all found it very difficult to move long distances. It was obvious in the case of wheelchair user and with ground mobility device that stepping out of the home was the first major barrier with uneven rural terrains which restrained the mobility of these devices for longer distances. Also these devices required high degree of physical effort to manoeuvre them in rural settings. One out of two tricycle users experienced moving long distances as very difficult while the other experienced it as difficult. Though tricycle was considered good for long distances, it required great effort to propel it mainly due to its

large size (weight) and its design. It was told by the respondents that sometimes while crossing a swampy street and an uneven mound, they required support from community members available on the village street. Also, some of the village streets were found to be so narrow that a tricycle could not enter those areas. Momin Ahmed (participant no. 17), a tricycle user used to thus park his tricycle in a wider street and then crawled to his home (in the narrow street).

Table 5.4 Mobility Device * Walking Long distances_PER Crosstabulation

			Walking Long distances PER			
			Very Difficult	Difficult	Neither	Total
Mobility Device	No Mobility Device	Count	19	9	0	28
		% of Total	44.2%	20.9%	.0%	65.1%
	Stick / Cane	Count	2	4	1	7
		% of Total	4.7%	9.3%	2.3%	16.3%
	Crutches	Count	4	0	0	4
		% of Total	9.3%	.0%	.0%	9.3%
	Ground Mobility Device	Count	1	0	0	1
		% of Total	2.3%	.0%	.0%	2.3%
	Wheelchair	Count	1	0	0	1
		% of Total	2.3%	.0%	.0%	2.3%
	Tricycle	Count	1	1	0	2
		% of Total	2.3%	2.3%	.0%	4.7%
Total		Count	28	14	1	43
		% of Total	65.1%	32.6%	2.3%	100.0%

Some of the qualitative experiences regarding mobility have been documented as follows:

Pinki's (Participant no. 8) parents informed that, "She falls down, after walking a little distance."

Shakeela's (Participant no. 15) mother told that, " She has great difficulty to walk with load on her head, which is a usual practice in villages to take water containers, other objects of daily use etc. She takes a smaller bucket to reduce the load to be carried."

Sattu's (Participant no. 18) family members narrated, "He is unable to cross drains and his knees get bruised while he crawls to his neighborhood. We put a cream(ointment) on his palms everyday as they get badly hurt while crawling. " (Fig. 5.1a,b,c)

Vinay (Participant No. 29) said, " I am unable to walk long distances. It pains a lot and I feel exerted."

Sandeep Kumar's (Participant No. 32) family members told, " He keeps sitting on the tube well, since he cannot move much."

Shahnaz (Participant no. 37) who owns a tricycle rickshaw expressed her views by saying, "There is no use of providing such rickshaws, which cannot work in the open drains in the village."

Farhat (Participant no. 39) fears using a stick, as she feels that she might fall walking with her one leg.

Mujameel Ahmed (Participant no. 40) informed that "Its difficult to walk in muddy terrains especially during rains."

Observations

Photo documentation was used as a powerful tool to aid the process of explaining through pictures the real life environment and the barriers associated with it. Figures shown below reflect the various mobility related issues in low income communities of rural environments as observed in the study area. Fig. 5.3 shows the village street with a small drain in its centre making Vikas (participant no. 1) unstable while walking. Fig. 5.5 and 5.6 show crutch being used as a mobility device. Fig. 5.6 also shows the difficulty in walking with another weight of a bucket. Figures 5.7 to 5.14 shows different postures adopted for mobility by the survey participants with mobility impairments. Figs. 5.15 to 5.17 show the various wheeling devices being used by various participants viz. tricycle and wheelchair.

Case Study 1

Momin Ahmed (respondent no. 17) crawls to move short distances within his house. He owns a tricycle, which being wider than his street lane where he lives. So he parks it in another wider street and from where he crawls (almost 200 feet) to reach his home. Fig. 5. 4 shows him crawling towards his tricycle from his home over a brick path. While brick

path on one side has an advantage of providing a hard stable surface to move, it becomes a hurting surface to Momin Ahmed, whose hands and knees get bruised while frequent crawling. As a result, he began to use his slippers as a hand gripping aid to prevent his palms getting bruised (Fig. 5.9).

Case Study 2

Fig. 5.15 shows the sequence of crossing a drain by Israr (respondent no. 38), a mobility impaired subject in the study area. The researcher observed on the site that the respondent did not have any mobility device and preferred a longer path to traverse, since he could not cross the drain otherwise. He then reached the stone slab and sequentially bent, squatted down and crossed over (Fig. nos. 5.13 a to f) the 9 inches wide drain and then stood up with his weak limbs to walk a short distance. It is important here to note the relevance of a stone slab as a facilitator over the drain.

Case Study 3

Fig. 5.14 shows a two step sequence of a drain being crossed over as a barrier by Farhat (respondent no. 39). Despite having a pair of crutches as a mobility device, she seeks human support (from her mother) to cross the drain in front of her house. Generally, even a small barrier like drain creates a wide gap between a mobility impaired individual and one's participation.

Barriers to Mobility

The following environmental barriers to mobility were observed during the survey :

Drains, hard surfaces, narrow pathways, uneven walking surfaces, thresholds, lack of support while walking, lack of resting spaces on pathways. Drain covers, wider pathways and leveled surfaces, though rarely sighted in the rural environments, would act as facilitators to aid mobility.

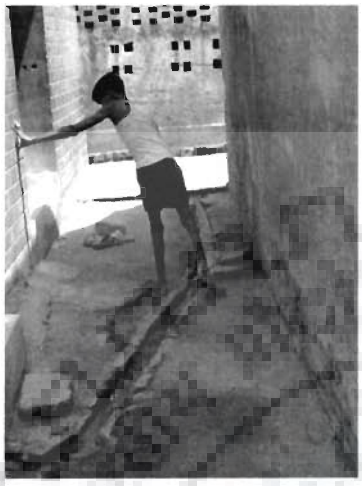


Fig. 5.3 Vikas using wall as a support to balance himself while walking over drain.

Fig. 5.4 Momin Ahmed crawls down on a brick path to board his tricycle.

Fig. 5.5 Farhat using crutches to aid mobility within her home.

Fig. 5.6 Babli Devi uses single crutch with bucket in other hand to walk towards a water source.

Fig. 5.7 Azad crawls bare hand in his home.

Fig. 5.8 Sonia crawls over a small mound in the village pathway.

Fig. 5.9 Momin Ahmed uses bathroom slippers as an aid to prevent his hands getting bruised.

Fig. 5.10 Sattu crawls over soft mud ground while simulating his mobility experience.

Fig. 5.11 Mukul moves in a bending posture over the wet mud pathway.

Fig. 5.12 Shahnaz moves in a L-shaped posture lifting one limb to cover short distances.

Fig. 5.13 (a) Israr bending to cross the drain.

Fig. 5.13 (b) Israr squats down to cross the drain over a stone slab.

Fig. 5.13 (c) Israr crossing the drain.

Fig. 5.13 (d) Israr standing up after crossing the drain.

Fig. 5.13 (e) Israr standing up after crossing the drain.

Fig. 5.13 (f) Israr walking along wall side as support for balance.

Fig. 5.13 Mobility activity sequence of crossing a drain by Israr (respondent 38)

Fig. 5.14 (a) Farhat before crossing the drain

Fig. 5.14 (b) Farhat while crossing the drain

Fig. 5.14 Farhat seeks human support from her mother to cross the drain in front of her house.

Fig. 5.15 Momin Ahmed using his tricycle.

Fig. 5.16 Pappu seated on his tricycle while guarding the mango trees against children in his village.

Fig. 5.17 Raj Kumar manoeuvring wheelchair in his residence.

5.3 CLIMBING RELATED ACTIVITIES

Climbing levels of varying degrees was a challenge to most persons with mobility impairments. The rural environments characterized with drains and high thresholds at the entrance formed common barriers for all those with limited mobility. The activity to move horizontally was also reduced due to the presence of undulating levels which created imbalance in the walking posture of the survey respondents. To understand the issues relevant to climbing activities, this theme is further divided into two sub areas viz. Climbing thresholds and climbing stairs. which formed a common medium for vertical circulation.

5.3.1 Climbing Thresholds

Presence of thresholds to separate two levels became a dividing element in the environment between the able bodied and the mobility impaired. While some of the ambulant disabled were still able to negotiate the thresholds, it was very cumbersome for the non ambulant disabled to cross one. Presence of thresholds in the rural environments was commonly observed at the 1.) entrance of the house 2.) in the toileting spaces 3.) around the water source 4) between the intermediate spaces in the house 5.) entrance of the community participation areas like school, primary health centre, religious centre etc.

Thresholds were the most common barrier which were observed at the entrance of every house. Thresholds ranged from a level of 9 inches to a maximum of 2 feet above the outside road level in the houses of survey participants. Only two participant's houses had a ramp at the entrance as an alternative to steps while most others had a single step to climb up or directly faced a threshold at the entrance. Another common feature was that every threshold was flanked by a continuous drain wherein the waste water from the houses gets discharged. To keep separation between dry and wet area, thresholds in the toilets and bathing spaces was considered necessary. It was also noted that though most houses had a threshold level higher in the toilets and bathing spaces than the floor level

outside, there were few observations in the participants houses where the bathing space was found to be much lower than the outside ground level (6inches to 1feet). Also, thresholds got created when the house got extended in phases and floor levels had to be bridged by steps.

The participants were asked to rate their perceptual experience about climbing thresholds in or outside their home environments (Fig.5.18). It was found that as many as 30 (70%) participants rated climbing thresholds from very difficult (21%) to difficult (49%). 11 (25%) participants rated it as neither difficult nor easy while 2 (5%) participants found it easy to climb thresholds. The variation in the response could be due to the varying degrees of disabilities and diverse forms of thresholds. Also the type of mobility device being used added to the degree of ease or difficulty. For example, a walking stick became a helping aid to climb levels while a wheeling device (wheelchair / tricycle) became a limiting factor in climbing up or down the levels.

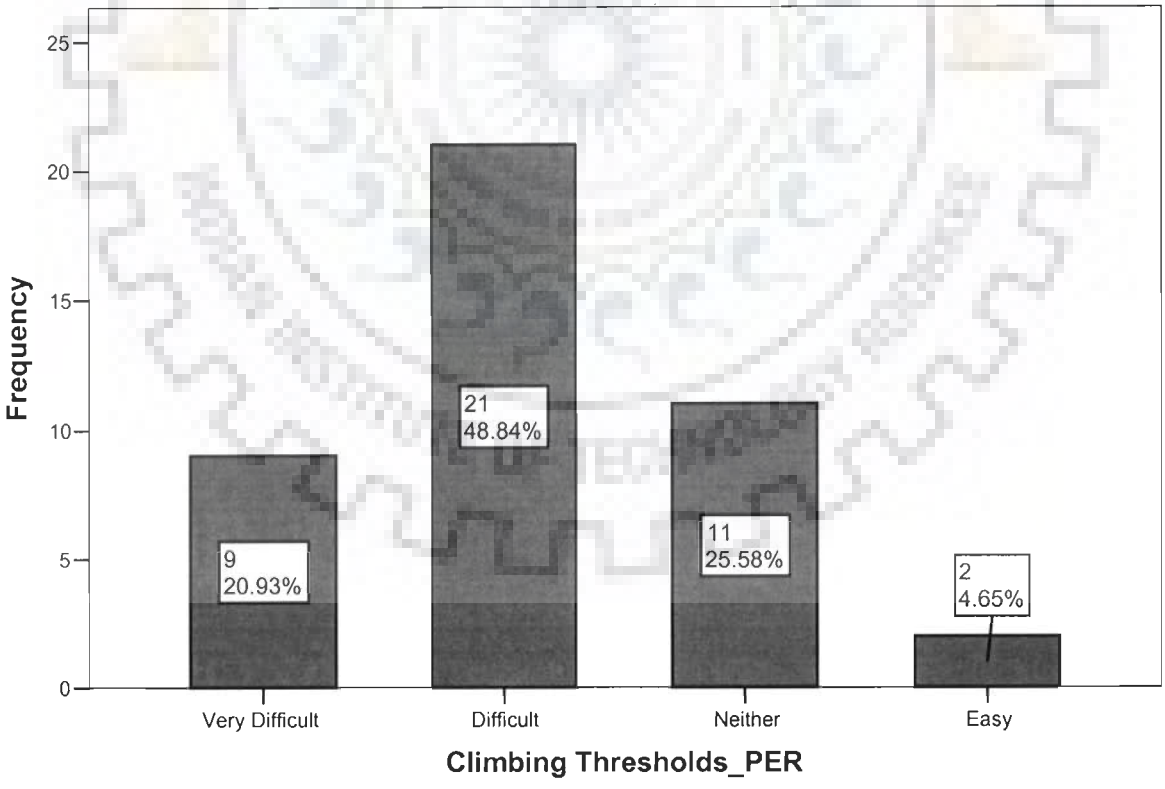


Fig. 5.18 Bar chart showing frequency distribution of degree of difficulty in Climbing Thresholds by survey respondents.

Table 5.5 shows the crosstab analysis between the type of disability and PER of climbing thresholds. It clearly shows that the non ambulant participants found it very difficult to climb thresholds. While in the ambulant category, only 2 participants found it very difficult and 16 of them found it difficult to cross thresholds in some form or other. 11 of the ambulant disabled rated their experience as neither difficult nor easy while 2 persons from ambulant category found it easy to negotiate with threshold levels.

Table 5.5 Disability Type * Climbing Thresholds_PER Crosstabulation

			Climbing Thresholds_PER				
			Very Difficult	Difficult	Neither	Easy	Total
Disability Type	Ambulant	Count	2	16	11	2	31
		% of Total	4.7%	37.2%	25.6%	4.7%	72.1%
	Non Ambulant	Count	7	5	0	0	12
		% of Total	16.3%	11.6%	.0%	.0%	27.9%
Total		Count	9	21	11	2	43
		% of Total	20.9%	48.8%	25.6%	4.7%	100.0%

The crosstab analysis in Table 5.6 projects the usability of a mobility device and the rating of climbing thresholds. It suggests that amongst people with no mobility devices, 6(14%) found it very difficult while 16 (37%) found it difficult to climb thresholds. Of them 5(12%) rated it as neither difficult, nor easy and 1 (2%) found it easy to climb. It is also observed that participants who used walking stick or cane as a mobility device did not have much difficulty in climbing thresholds as only 1 (2.3%) out of 7 stick users found it difficult. Out of the rest 6 participants who used stick as a mobility device 5 found it neither easy nor difficult to climb thresholds while 1 of them found it easy. This shows the extent of usability of a simple walking aid like stick which is cheap to afford and yet functionally supportive to climb thresholds. However, it may also be noted that a stick was not considered very supportive by survey participants to walk long distances. It was also found from the analysis that all participants using wheeling devices for mobility experienced difficulty in crossing thresholds, since the common wheeling devices (like a ground mobility device, wheelchair or tricycle) had a limitation to climb up high thresholds.

Table 5.6 Mobility Device * Climbing Thresholds_PER Crosstabulation

			Climbing Thresholds_PER				
			Very Difficult	Difficult	Neither	Easy	Total
Mobility Device	No Mobility Device	Count	6	16	5	1	28
		% of Total	14.0%	37.2%	11.6%	2.3%	65.1%
	Stick / Cane	Count	0	1	5	1	7
		% of Total	.0%	2.3%	11.6%	2.3%	16.3%
	Crutches	Count	1	2	1	0	4
		% of Total	2.3%	4.7%	2.3%	.0%	9.3%
	Ground Mobility Device	Count	0	1	0	0	1
		% of Total	.0%	2.3%	.0%	.0%	2.3%
	Wheelchair	Count	1	0	0	0	1
		% of Total	2.3%	.0%	.0%	.0%	2.3%
	Tricycle	Count	1	1	0	0	2
		% of Total	2.3%	2.3%	.0%	.0%	4.7%
Total		Count	9	21	11	2	43
		% of Total	20.9%	48.8%	25.6%	4.7%	100.0%

Qualitative observations through live simulation by the participants and photo documentation reveals a further insight into the issues of climbing thresholds by mobility impaired survey participants. For respondents who had to crawl, found it very cumbersome to transfer their bodies up or down the level. Almost all non ambulant persons reported that it soils their clothes while climbing up or down the thresholds. Several among them pointed that it required an extra physical effort to climb up, so many a times they had to depend on human support rendered by their family members or friends from the community. For the ambulant disabled, crossing levels led to an imbalance and hence needed a support to hold. Fig. 5.20 (a,b) shows Ram Kishore (respondent no. 6) crossing a 3 inches high level as a separation between inside room and verandah of the house using the side wall as a support. Fig. 5.21 (a to e) documents the threshold climbing activity within his house by Sattu (respondent no. 18). Figures 5.22 and 5.23 show Vinay (respondent no. 29) and Shahzadi (respondent no. 34) using their walking aids i.e. stick and crutch respectively to climb entrance steps of their residences. Fig.5.24 shows Pankaj (respondent no.4) using a ramped approach to climb up the level while Fig. 5.25 shows Sushma (respondent no. 7) using steps as a convenient mode of climbing levels.

Fig. 5.19 (a) Mukul climbs down a high threshold.

Fig. 5.19 (b) Mukul climbs up a high threshold.

Fig. 5.20 (a) Ram Kishore crossing threshold of his room.

Fig. 5.20(b) Ram Kishore balancing with wall support after crossing threshold.

Fig. 5.21(a) Sattu, maintaining posture to climb down the threshold in his house.

Fig. 5.21(b) Sattu, climbing down.

Fig. 5.21(c) Sattu, after climbing down the threshold.

Fig. 5.21 Sattu simulating the activity of climbing over a 1'-9" high threshold in his house.

Fig. 5.21(d) Sattu, in an onward posture to climb up the threshold.

Fig. 5.21(e) Sattu, in the process of climbing up the threshold.

Fig. 5.22 Vinay climbing thresholds of his house using stick.

Fig. 5.23 Shahzadi stepping on a stone cover with crutches to climb up the level to enter her house.

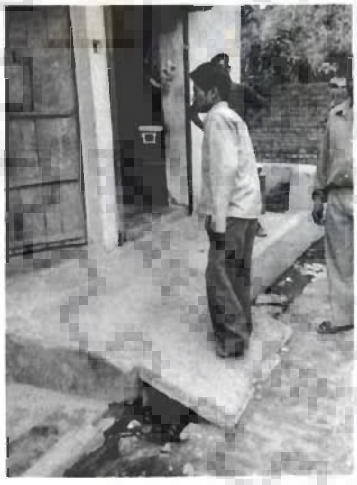


Fig. 5.24 Pankaj using a ramped approach to climb threshold level to his house.

Fig. 5.25 Sushma climbing steps to cross levels within her house.

5.3.2 Climbing Staircases

Most of the dwellings in the study area were single storied structures with activities predominantly scattered at the ground level. Staircase was though considered an important element in some houses for approaching the terrace for diverse functions like drying clothes, sleeping at night (by male members of the family) or for leisure activities by children. For the mobility impaired, though it was not a functional necessity to climb a staircase, it was definitely an option which was difficult for them to access. One of the participants informed that she uses terrace to take bath as there was no privacy in the bathing space on the ground floor.

Staircases in the village environments of the study area were found to have diverse characters in terms of their elements like treads, risers, side supports etc. Some of them were open on both sides (Fig. 5.26 a,b) while few among them had wall on only one side (Fig.5.28 a,b and 5.29 a,b) and the rest were flanked by walls on either side (Fig.5.27 a,b). However, stairs with grab bars or a gripping surface were found in none of the participant homes. The major difficulties pointed out by the respondents were postural imbalance while climbing due to lack of support, tiredness as a result of greater physical exertions to climb, knee injuries for those who were non ambulant as risers as high as 1'-0" or 1'-3" was a common sight. It was also reported by two respondents, that climbing stairs to them was easier than climbing thresholds.

Some of the qualitative responses as given by the participants are presented below :

Sushma (respondent no. 7) said, " It is difficult to climb staircases. Walking Stick doesn't help much and there are no handrails to aid climbing. "

Randheer (respondent no. 13) said, " It would be easier to climb staircase if supports are there on both sides. Parapet wall would solve the purpose."

Azad (respondent no. 3) shared, " I am used to climbing this way only on the open staircase. Sometimes my elder brother lifts me in his arms and takes me to the terrace. "

Fig. 5.26(a) Azad climbing up a staircase with no side supports.

Fig. 5.26(b) Azad climbing down on a staircase with no side supports.

Fig. 5.27(a) Neeraj climbing on a staircase with both side walls.

Fig. 5.27(b) Neeraj climbing down a staircase while balancing with both side walls as support.

Fig. 5.28 (a) Sushma climbing up a staircase with one side wall and other side parapet.

Fig. 5.28 (b) Sushma climbing down a staircase with one side wall and other side parapet.

Fig. 5.29 (a) Ramkishore climbing up a staircase with support of a parapet on one side and stick on the other.

Fig. 5.29 (b) Ramkishore climbing down a staircase with support of a parapet on one side and stick on the other.

5.4 TRANSFER ACTIVITIES

Transfer activities in the context of this study refers to the act of transferring of the mobility impaired participants from one position to another either by themselves or through human support to facilitate performance of other ADLs. In most cases a transfer activity became a crucial intermediate activity (sub activity) which led to further performance of other activities. Also, it was observed that the need for transfer was most critical for the non ambulant category of the mobility impaired participants. The need to highlight transfer activities is to bring to light the issues that are experienced by the respondents which become the barriers to participation in greater activities.

Case Study 1

This refers to the case of Raj Kumar (participant no. 2) who is a non ambulant participant and uses a wheelchair or a ground mobility device for his mobility within the home and a motorized tricycle for moving outdoors. For performing activities like toileting and bathing, he needs to transfer himself from the seated position on his bed to wheelchair to the ground mobility device (Fig. 5.30 a,b,c) through which he further reaches the space of activity performance. Fig. 5.30 a to c show the sequence of transferring as simulated by Raj Kumar during the survey. It shows him first pulling his wheelchair near the bed to enable a sideways transfer which was considered to be much easier than a frontal transfer. In the second step, it shows him turning sideways to adjust his posture for lowering down his body in order to transfer himself to his ground mobility device. In the third step, he is leaving his hand from the wheelchair to propel on his ground mobility device. Fig.5.30 (d) & (e) shows the transfer in action from wheelchair to his motorized tricycle.

Fig. 5.30 (a) Raj Kumar pulling the wheelchair closer for ease in sideways transfer.

Fig. 5.30 (b) Raj Kumar transferring himself from wheelchair to the ground mobility device.

Fig. 5.30 (c) Raj Kumar on his ground mobility device, after transfer.

Fig. 5.30 (d) Raj Kumar transferring from wheelchair to his motorized tricycle.

Fig. 5.30 (e) Raj Kumar seated on his motorized tricycle.

Case Study 2

This case study refers to the transfer activities of Sattu (participant no. 18) who is also non ambulant and does not possess a mobility device either. The figures given below show the process of transferring him to the hand pump (water source) in three steps. Fig. 5.31(a) shows Sattu being lifted by his brother from the cot and then taken to the hand pump space (Fig. 5.31 (b)). Finally he is positioned near it for performing his activity (Fig.5.31(c)). After he completes his activities, he is again lifted back to the inside space.

Further, Fig. 5.32 (a to c) show Pappu (respondent no.30) transferring himself from ground level to his tricycle. This forms a regular feature of his daily activities. It was observed that with the help of simple assistive aids, transferring could be made easier for people with mobility impairments.

Fig. 5.31 (a) Sattu being lifted from cot by his brother as a transfer activity.

Fig. 5.31 (b) Sattu being brought down from his care giver's arms.

Fig. 5.31 (c) Sattu being placed near the hand pump for performing his further activity.

Fig. 5.32 (a) Pappu holding the tricycle frame to transfer himself.

Fig. 5.32 (b) Pappu transferring to the leg space in his tricycle as an intermediate step.

Fig. 5.32 (c) Pappu finally transfers on to his tricycle seat.

5.5 SELF CARE ACTIVITIES

Self care activities include sanitation activities like fetching water, toileting and bathing for the purpose of this study. Calls of nature are a universal concept. However, patterns of performing those tasks differ from region to region. Every society with time has advanced and developed its own style of performing these activities which is how they are termed normal in their context. For example, Western style of toileting used to be an alien concept to the Indian rural settings and hence considered a style of higher status. The domain of self care activities as studied in the context of mobility impaired persons in the rural environments is an investigation about understanding the ways in which they perform these activities in the available infrastructure at household or community level.

5.5.1 Fetching Water

Unlike urban setups of piped water supply in every home, direct water source was not available in all dwellings of the study area. However, water remains a prime element for performing all activities of self care. Hand pumps were installed either in the residences of the survey participants or they had to fetch water from the nearest community hand pump. Amongst 43 respondents, 24 of them had a hand pump in their homes, while 17 participants relied solely on community hand pump and only 2 participants had a piped water supply in their residences. Fetching water was considered an activity which facilitated the performance of other activities like toileting, bathing, household works like washing clothes/utensils, cooking and drinking. Fetching water could be divided into two sub themes viz. Water collection and water transportation. It was thus observed that hand pumps were the most commonly used source for collecting water while it was transported for use in containers like steel buckets (15 to 20 Litres), plastic jerry cans (upto 5 Litres capacity), plastic water bottles (1 to 2 Litres capacity) or earthen pots. As discussed earlier, limited mobility owing to several personal and environmental factors also had an impact on the activity of fetching water. Many respondents expressed high discomfort in carrying water, as it was much difficult to walk with weight than without

it. Figure 5.33 suggests the perceptual experience rating of the participants for fetching water. It shows that as many as 17 (40%) participants found it very difficult to fetch water while 15 (35%) rated their perception as difficult while 11(26%) participants rated their experience as neither difficult nor easy. Mobility device became an added botheration in case of transporting water, since either one or both hands would be occupied by devices like crutches, stick etc and the extra weight caused imbalance on the uneven pathways. For a tricycle or wheeling device bound person, it required tedious transferring (self or assisted) to the space near the water source to fetch water.

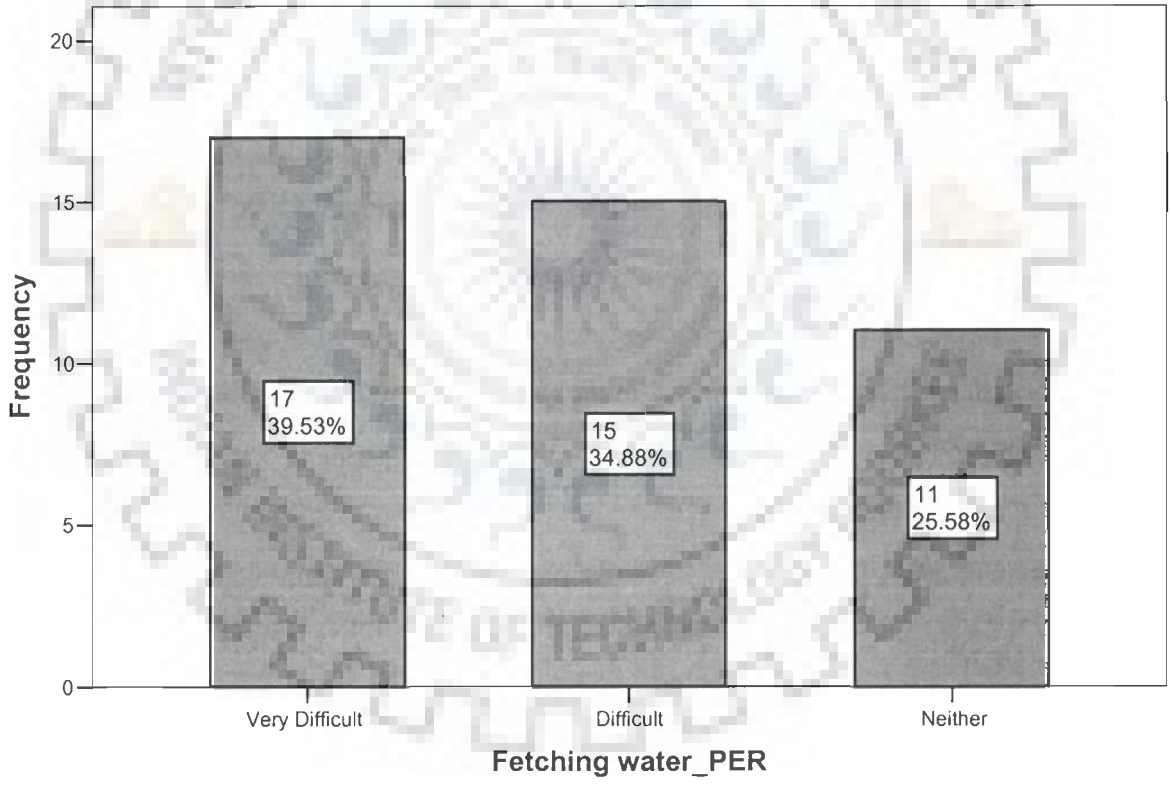


Fig. 5.33 Bar chart showing frequency distribution of degree of difficulty in Fetching Water by survey respondents.

Further analysis through crosstabulation (Table No. 5.7) reveals that almost all non ambulant participants (11 out of 12) had great difficulty in fetching water while 1 of them rated his experience as difficult. 6 (14%) participants in the ambulant category found it very difficult and 14 (32.6%) found it difficult to fetch water while 11 of them rated their experience as neither difficult nor easy.

Table 5.7 Disability Type * Fetching water_PER Crosstabulation

			Fetching water_PER			
			Very Difficult	Difficult	Neither	Total
Disability Type	Ambulant	Count	6	14	11	31
		% of Total	14.0%	32.6%	25.6%	72.1%
	Non Ambulant	Count	11	1	0	12
		% of Total	25.6%	2.3%	.0%	27.9%
Total		Count	17	15	11	43
		% of Total	39.5%	34.9%	25.6%	100.0%

While discussing about the barriers to fetch water, non availability of water source in proximity was pointed out as the first critical barrier especially for those who did not have a water source in their homes. Crossing thresholds of one's own house, uneven pathways to walk and compounded by steps or a raised apron or plinth around the water source (hand pump) were some of the other commonly listed barriers. For the crutch users and the cane users, it was very difficult to hold the water container along with their mobility devices which became an added botheration. Apart from this, it was pointed out by the crutch users that keeping their assistive device on the ground was yet another barrier. Hand pump handle served the purpose of a support to stand up or sit down for most of the ambulant disabled participants. Some of the non ambulant participants informed that they normally relied on family members for their water needs.

Table 5.8 shows the crosstab analysis between the mobility device used by the participants versus the perceptual experience rating of fetching water. It further shows that out of 7 stick users, 4 found it quite difficult while 3 expressed their rating as

neither difficult, nor easy. Amongst the 4 crutch users, all of them rated their experience of fetching water as very difficult. One of the survey participants said, "Since water is almost a necessity, and I feel the burden of my disability on others. Many a times, I prefer to go on my own to the water source. However, it is a difficult job for me as it pains in my lower limbs while walking on uneven grounds." Also, it is important to note here that all survey participants with wheeling devices perceived the process of fetching water as very cumbersome. Both the tricycle users reported an observation suggesting that there was not enough manoeuvring space near the community hand

Table 5.8 Mobility Device * Fetching water_PER Crosstabulation

			Fetching water_PER			
			Very Difficult	Difficult	Neither	Total
Mobility Device	No Mobility Device	Count	10	10	8	28
		% of Total	23.3%	23.3%	18.6%	65.1%
	Stick / Cane	Count	1	3	3	7
		% of Total	2.3%	7.0%	7.0%	16.3%
	Crutches	Count	2	2	0	4
		% of Total	4.7%	4.7%	.0%	9.3%
	Ground Mobility Device	Count	1	0	0	1
		% of Total	2.3%	.0%	.0%	2.3%
	Wheelchair	Count	1	0	0	1
		% of Total	2.3%	.0%	.0%	2.3%
	Tricycle	Count	2	0	0	2
		% of Total	4.7%	.0%	.0%	4.7%
Total		Count	17	15	11	43
		% of Total	39.5%	34.9%	25.6%	100.0%

pump for their wheeling device. As a result they both had to get down from their tricycles a little distance ahead of the water source and then soil their clothes crawling on the road surface to get closer to the water source. One of them pointed out the problem of getting back to the tricycle even worse because while crawling back with wet hands, dirt would stick on to his hands rendering them unusable for other activities. As a result he used to take off his rubber slippers and wear them in his palms to take care of the above problem.

Fig. 5.34 and 5.35 suggest the two most common designs of community hand pumps in the study area. The circular hand pump space (Fig. 5.34) with a 6 feet diameter has a hand pump on its one end and flanked by a drain on the other. It is important to note the levels and the unevenness around the hand pump space as the most prominent barriers to access for persons with limited mobility. Steps on its (left) side provide for the only possible approach route to the hand pump which makes it further difficult to access. However, the square shaped space around the hand pump (Fig. 5.35) shows a high plinth (9 inches) reported as a barrier to access. In one of the community locations near a participant's house the hand pump shown in Fig. 5.36 was sighted which was considered a facilitator for easy access as it had a leveled approach with the circular cemented apron 3 inches down. Though, it was located in a corner, it was completely approachable from one side by any person with mobility limitations. Fig. 5.37 shows, a participant (Babli Devi) standing on an uneven ground around the hand pump space with one hand holding the crutch and with other trying to hold the hand pump handle as a support to stand. Fig. 5.38 shows a non ambulant participant (Momin Ahmed) using hand pump while sitting in the apron space. It was further noted that the direction of the hand pump handle and the outlet formed yet another important feature to be considered. The handle of handpump at the time of installation could be either diametrically opposite to the outlet (Fig. 5.34) or could be in the direction of the outlet (Fig. 5.36, 5.38) or it could be at an angle of 90 degrees to the outlet (Fig. 5.39, 5.40). The 180 degrees configuration of handle and outlet was helpful when one had a helper to assist the water flow while the user could sit near the outlet. The parallel configuration of a handle over the outlet though was intended for spaces where there was not enough space in the background for a long handle to be installed, it was useful for self assisted use of hand pump. Since, community hand pump spaces were used for multipurpose activities like bathing, washing etc., the parallel configuration was not considered a very comfortable option by the users. The right angled configuration was found to be the most desirable by persons with mobility impairments.

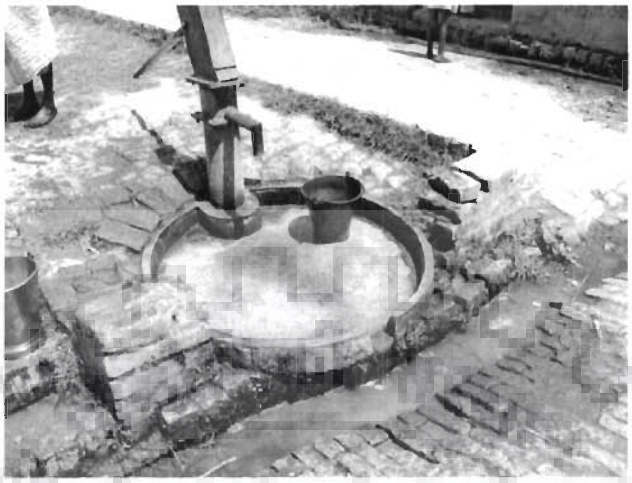


Fig. 5.34 Typical Community Hand pump with a circular apron in the study area.

Fig. 5.35 Typical community Hand pump space with a square plinth around it in the study area.

Fig. 5.36 Typical community Hand pump space with a leveled approach from one side in the study area.

Fig. 5.37 Babli Devi on single crutch standing on an uneven ground while trying to hold handpump handle for support.

Fig. 5.38 Momin Ahmed a tricycle user operating hand pump from the side.

Fig. 5.39 Randheer using hand pump in his home with no thresholds around.

Fig. 5.40 Shahnaz using a hand pump from a seated position with a handle in right angled configuration.

Fig. 5.41 Rajkumar using a hand pump from a seated position in wheelchair with a handle in right angled configuration.

Fig. 5.42 Babli holding crutch in her impaired limb while fetching water.

Fig. 5.43 Babli sitting on a swampy ground while fetching water from hand pump.

Fig. 5.44 (a) Shakeela fetching water from hand pump with leveled space around.

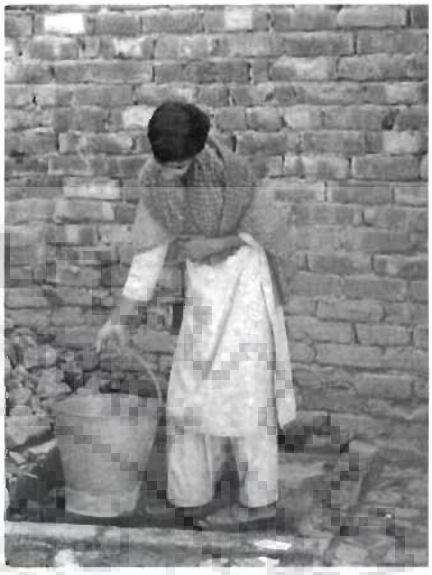


Fig. 5.44 (b) Shakeela transporting water in a bucket for use at home.

Fig. 5.45 Vikas drinking water from a community tap stand at a low height.

Fig. 5.40 and 5.41 show the varying heights of accessing a hand pump which could be facilitated by extending the length of the handle. Fig. 5.42 shows the survey participant holding the crutch in her amputated limb while standing on single foot on an uneven platform to fetch water from the hand pump. Fig. 5.43 shows the same participant (Babli Devi) squatting in the swampy area around the hand pump. Transporting water was found to be yet another challenge for the persons with lower limb impairments. Since, walking with carrying weight became an extra burden, many of the ambulant participants told that they used to either fill the bucket half its actual capacity whenever they had to carry water from the water source to a distance. Fig. 5.44(a,b) show a survey participant (Shakeela) fetching water in a bucket from the hand pump and then lifting it by herself to carry it for further use. Taps, as a water source were not a very common sight in the rural environments, since all villages did not have a water line connection. However, while discussing with participants there was a consensus on the fact that a tap is easy to operate but was considered unreliable due to fixed timings of water supply. Also, being expensive to lay a pipeline for installing a tap stand as an option did not gather much interest. Fig. 5.45 shows a community tap stand on a village street being used by a participant for drinking water. Fetching water at night from a distance was considered even more challenging than during day time due to lack of lighting on the streets.

5.5.2 Toileting

Toileting is an integral part of one's daily biological activity with no choice. It is also considered important to keep body hygiene as a part of one's daily routine irrespective of age, gender, caste, creed or socio economic differences. Yet, what becomes the differentiating factor is the ease or difficulty of its performance by the ones with impaired mobility. The context of environment is found to greatly influence the cultural acceptability, human adaptability and economic appropriateness in the performance of such activities of self care.

Through a detailed survey, observation and discussions, several insights into the activity of toileting were gained. All the participants were asked to rate their perceptual experience of toileting on a unipolar 5 point rating scale as done with other ADLs. Fig. 5.46 shows a detailed account of the participant's responses. It shows that 9(21%) respondents found it very difficult to complete the toileting activity while as many as 18(41%) participants rated their experience of toileting as difficult. 14 (33%) participants expressed their experience as neither difficult nor easy while 2 (5%) participants expressed their perceptual experience as fairly easy. To further understand the issues related to toileting, it is important to know the various types of toileting environments. It was found that people had almost four different spaces for defecation.

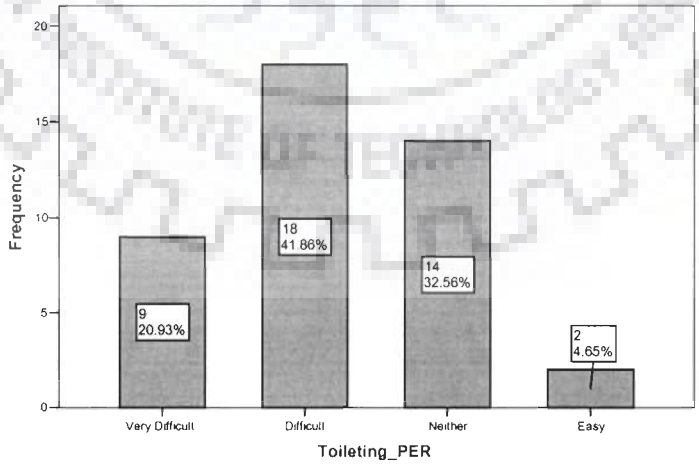


Fig. 5.46 Bar chart showing frequency distribution of degree of difficulty in Toileting by survey respondents.

Table 5.9 shows a crosstab analysis between the disability type and the perceptual rating as experienced by the survey subjects for toileting activity. It reflects that all non ambulant participants experienced great difficulty in toileting with 6 of them rating it as very difficult and the other 6 as difficult. In the case of ambulant disabled, 3 of them rated it as a very difficult experience and 12 as a difficult one. 14 participants in the ambulant category rated their experience as neither very difficult nor difficult and 2 of them had an easy experience performing the toileting activity. These experiences are though an outcome of complex interactions between the personal and environmental factors, it would be difficult to single out the most important factor owing to conducting this study in natural settings wherein, the variables cannot be controlled to a great extent.

Table 5.9 **Disability Type * Toileting_PER Crosstabulation**

			Toileting_PER				
			Very Difficult	Difficult	Neither	Easy	Total
Disability Type	Ambulant	Count	3	12	14	2	31
		% of Total	7.0%	27.9%	32.6%	4.7%	72.1%
	Non Ambulant	Count	6	6	0	0	12
		% of Total	14.0%	14.0%	.0%	.0%	27.9%
Total		Count	9	18	14	2	43
		% of Total	20.9%	41.9%	32.6%	4.7%	100.0%

The participants were asked as to how far they had to traverse to perform the activity. Their responses were coded as Toileting_Perceptual distance which were then analyzed through crosstabs with their PER for the activity. Table 5.10 presents the detailed picture of the same. It shows that out of 24 participants who performed toileting in the designated spaces within their homes 12 (50%) rated their experience as difficult while 10 of them said neither difficult, nor easy. Amongst the ones who went for toileting in the near vicinity, 5 rated some degree of difficulty in performing the activity while 1 participant felt neither difficult, nor easy to perform the activity. It then becomes important to note that 10 out of 13 participants who used a toileting facility quite far from their homes, expressed some degree of difficulty in performing the toileting activity. It was observed that to a non ambulant person with disability, moving a small

distance was a big task overcoming several difficulties as compared to an ambulant disabled person, who with some degree of mobility is able to walk.

Table 5.10 Toileting_Perceptual Distance * Toileting_PER Crosstabulation

			Toileting_PER				
			Very Difficult	Difficult	Neither	Easy	Total
Toileting_ Perceptual Distance	In the house	Count	4	8	10	2	24
		% of Total	9.3%	18.6%	23.3%	4.7%	55.8%
	Near the house	Count	2	3	1	0	6
		% of Total	4.7%	7.0%	2.3%	.0%	14.0%
	Quite far from the house	Count	3	7	3	0	13
		% of Total	7.0%	16.3%	7.0%	.0%	30.2%
Total		Count	9	18	14	2	43
		% of Total	20.9%	41.9%	32.6%	4.7%	100.0%

Further crosstab analysis was done between the mobility device in use and their perceptual ratings for the activity. It is evident from Table 5.11, that persons who did not have any mobility device had diverse experiences ranging from very difficult to easy. This was primarily due to their degree of disability as a personal factor and other mix of factors such as reach, access, use, safety and privacy. Amongst the 7 respondents who used stick/cane as a mobility aid, 2 (5%) found it difficult to perform toileting while 5 (11.5%) of them rated their experience as neither difficult nor easy. For crutch users, toileting was rated as a difficult experience. 1 (2%) of them rating it as very difficult while the rest 3 (7%) rated their experience as difficult. It is clear from the crosstab presented below that for all subjects who used wheeling devices for mobility, toileting was a difficult experience.

Table 5.11 Mobility Device * Toileting_PER Crosstabulation

			Toileting_PER				
			Very Difficult	Difficult	Neither	Easy	Total
Mobility Device	No Mobility Device	Count	6	11	9	2	28
		% of Total	14.0%	25.6%	20.9%	4.7%	65.1%
	Stick / Cane	Count	0	2	5	0	7
		% of Total	.0%	4.7%	11.6%	.0%	16.3%
	Crutches	Count	1	3	0	0	4
		% of Total	2.3%	7.0%	.0%	.0%	9.3%
	Ground Mobility Device	Count	0	1	0	0	1
		% of Total	.0%	2.3%	.0%	.0%	2.3%
	Wheelchair	Count	1	0	0	0	1
		% of Total	2.3%	.0%	.0%	.0%	2.3%
	Tricycle	Count	1	1	0	0	2
		% of Total	2.3%	2.3%	.0%	.0%	4.7%
Total		Count	9	18	14	2	43
		% of Total	20.9%	41.9%	32.6%	4.7%	100.0%

Qualitative Analysis

To gain a greater insight into the understanding of the toileting as an activity and the sub activities involved in it, the participants were asked questions in a semi structured interview format and also they were asked to simulate the activity in their own environment so as to facilitate the researcher with deeper understanding and to aid the process of photo documentation. A qualitative analysis was then done on the basis of the following terms which have been operational in the context of this study for understanding this phenomenon (Table 5.12).

Table 5.12 Operational Definitions of Parameters

S.No.	***Parameters***	***Definition***
1	*Reachability*	*Ability to reach from the station point to the location where one performs that ADL.*
2	*Accessibility*	*Ability to enter and exit from the facility*
3	*Usability*	*Ability to use the space and complete the ADL*
4	*Safety*	*The sense of imbalance, lack of support wrt the ADL*

5	*Privacy*	*The feeling of being secured and not being looked over while ADL is under performance*

Reachability & Proximity

Reachability as a phenomena or sub activity depended upon, how far or near the toileting space was located from the user's station point. Generally, as the routine of all participants suggested that they go for toileting during the early morning. For the ones who did not have a toilet facility at home, had to walk some distance to reach the agricultural fields. Also, there were few participants in the non ambulant category who had to go to farms for defecation. They would then go crawling or were provided assistance / carried by a family member to the field. The process of reach became even more critical for female members to defecate in the open fields behind the bushes or standing crop. Carrying water along from a water source (handpump) at home or from the nearby community handpump became an added burden for the people with mobility impairments. The distance for toileting outside their own homes varied from 100 feet to 600 feet approximately. The environmental barriers on the way included barriers to mobility like high thresholds, uneven walking surfaces, swampy grounds, open drains to cross with an added barrier of fetching water from community hand pump for some of the respondents.

Toilets that were located in the home did not have proximity as an issue for reach. However, the degree of disability and the environmental interactions created a variable experience of reach for all the participants. For example, Raj Kumar (respondent no. 2) who is non ambulant used the toilet in his own house after transferring himself onto a mobility device created for his personal use. Though, the process of transferring, undressing and managing to reach the toilet was cumbersome (as observed during the simulation), his perception of reachability was good. On further elaboration, he reported that he has been doing this way for many years. So, he has adapted this

particular way of toileting and doesn't find it much problematic to reach from his living space to the toilet. However, he added to the discussion by saying," I keep a bottle near my bed to urinate, as its very cumbersome to even traverse a small distance for this activity."

Following responses by the survey respondents shall help in understanding the issues with greater detail :

Vikas (respondent no. 1) was the only respondent among others who used ramp to reach the toilet. Even though the ramp was steep, he preferred to use that, since it was available as an option. (Fig. 5.48). This was a brick coba ramp with a slope of 1:8.

Sattu (respondent no. 18) who was yet another case of non ambulant disability, had to be carried in the arms of a personal assistant (generally elder brother or mother) to the toilet.

Deepak (respondent no. 26) had a restricted mobility within his house environment and did not have a toilet facility at home. While other family members defecated in the agricultural fields on the fringe of the village, Deepak had to defecate in the open area in the house. His mother did the role of cleaning the soil.

Sagar's (respondent no. 28) mother informed, that she accompanies Sagar to farm for toileting as he usually falls down on an uneven path. During rains, he defecates at home only while he urinates in the drain outside.

Rajender (respondent no.27) told, " I get up at 4 am to go for toileting in the farms. Have to carry water over a distance on the uneven pathways. During rains it's a double trouble to carry an umbrella and a can of water with my mobility constraints."

Arvind (respondent no. 36) shared his experience by saying, "Toileting is more difficult than bathing. As for toilet, I have to go far in the fields. Someone else helps me by carrying water. It takes 10 to 15 minutes time to reach the fields, one way. "

Accessibility

Accessibility refers to the ingress/egress into and from the toileting space in this context, which is usually controlled by the thresholds, opening size and type and approach to the toileting system inside. The three components are discussed below, sequentially.

Thresholds

Thresholds as observed were ranging from 5" high to 12" high in most cases. Some participants said, that they had to use door as a support to climb the thresholds since there was no other support mechanism. One respondent encountered threshold as a barrier because it was 1'-0" down from the outside floor level (Fig.5.58 c). Only two respondents out of all had a toilet with negligible drop (Fig.5.54). This formed a convenience for the mobility impaired member of the family.

Opening Size and Door Type

The doors were observed to be mostly (wood) battened or clear opening with a cloth piece hanging from a steel rod. The cloth could alternatively be replaced by a jute sack or plastic sheet (Fig. 5.56). For those who couldn't afford to have a proper door, this was considered to be a cheap alternative, even though this mechanism had no system of bolting . In very few cases, steel doors were also used. Handles for opening and closing were rarely sighted in the battened doors while steel doors had fitted handles and bolting mechanism. Several toilets were observed without doors, which had used a cloth or a piece of plastic or a jute bag hanging over a steel rod as an alternative to door. This was found to be a cost effective solution to solve the purpose of screening oneself while

performing the function of toileting. A convenient reachable height for closing the door from inside was between 2ft. 6in. to 3ft.

One of the problems sighted in the doors was their closing mechanism. Latches or iron chain or a rope/string were the common mechanisms to bolt the door from inside. Observations from Fig. 5.64 (c) suggest that, while the door had a string to pull, it had no mechanism inside to hold or tie the string to the wall surface. As a result, Israr (respondent no. 38) had to keep holding the string from inside with one hand and with the other hand, he held the jamb wall to keep balance while squatting.

Approach to the toilet – sideways / frontal

The approach to the toilet was usually from the front (Figs.5.49 to 5.51) as a usual practice and the door width ranged between 23in.(1ft.11in.) to 27in.(2ft.3in.) in most cases. It was commonly observed that a frontal approach required a 180 degrees turn for the respondent while entering, as compared to a sideways approach which required a 90 degrees turn to position oneself for the activity and another 90 degrees turn to move out, once the activity is completed. This was considered to be difficult particularly for non ambulant category of mobility impaired participants who had to turn in sitting position for using their wheeling device (Fig.5.61c,d,e). Also, in a frontal approach for users on wheels, the internal manoeuvring for transfer was found to be very cumbersome. The respondents were asked as to whom did they consult while deciding the approach for toilet and constructing it. A spontaneous reply from most respondents was that either the construction was done long time before wherein they were too young to be considered as contributors to the thought process or based on the experience of the family head they were self built by the family members (to save labour cost). Some respondents reported that the family head discussed about the construction plan with close acquaintances from their community and then was accordingly planned and constructed. It was also mentioned by most respondents, that constructing toilets was never considered a serious criteria as was being realized with

the presence of a disabled family member. In one of the cases, the toilet was constructed alongwith a bathroom (for respondent no. 10, Meera Devi) through the government scheme for below poverty line.

Usability

The internal use of toilet depended upon its overall typology, size, support system, water support, flooring and ventilation.

Toilet typology

Unlike urban toilets, lack of proper designated toilets with fixtures, no water supply compounded with barriers of high thresholds and narrow door openings characterized the toileting spaces in the study area comprising rural environments. However, four types of toileting systems were observed to be in use by the survey participants viz. a) open space in the house b.) an enclosed space with raised platforms in (un plastered or plastered) brick masonry (Fig. 5.50, 5.52) c.) an enclosed space with an Indian type sanitary seat and (Fig. 5.51, 5.53) d.) open agricultural fields/farms. (Fig. 5.55). Fig. 5.47 shows the distribution of participants based on the toileting system they used. 14(33%) out of 43 participants had to go to open agricultural fields for toileting. Only one (2%) participant performed this activity in the open space of his house under the supervision of a caregiver. 8(19%) went to toilets defined as enclosed spaces with no sanitary fixture within their own household, while 20(47%) respondents had a toileting space with an Indian seat in it. Few of these toilets had a piped water supply while the rest depended upon a system of portable water in a container. The entire activity of toileting was understood as a series of sub activities to complete the whole process. This was primarily due to a long distance walk over an uneven pathway which also induced pain in their gait. As a result, the whole activity of toileting would become very cumbersome.

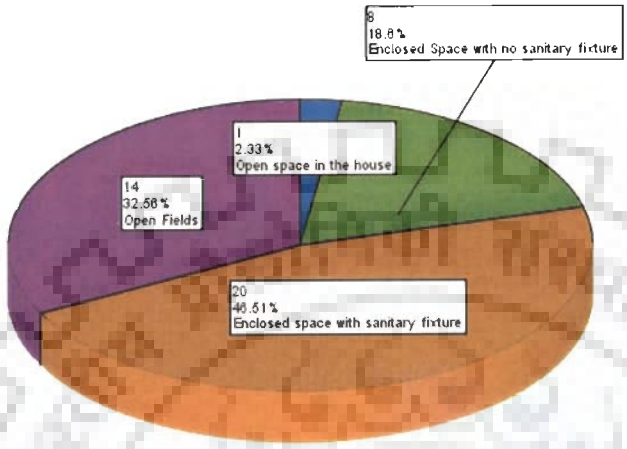


Fig. 5.47 Pie chart showing frequency distribution of type of toileting spaces being used by survey participants.

Internal Dimensions and Layout

The dimensions of toilets observed during the survey were of varied sizes. Though layout was mostly common with a frontal approach to the Indian seat. However, there were few cases where there was a sideways approach to the enclosed toilet, with brick or cement seats. Layouts were rectangular in profile with varying internal dimensions of like 2'10"x 4'5", 3'4"x 2'7", 3'5"x3'8", 2'9"x3'0". There was no specific reason available for the varying sizes, except for a general statement made referring to the available space in the house as a deciding criteria. Most toilets were located adjacent to the bathrooms abutting the front wall of the house. It was surprising to note that availability of space was very much unlike urban setups where spaces are governed by the tight envelopes of the built form. Because of a large open space in the rural context, some freedom of size could be leveraged which was not properly utilized by the respondents or their families in the study area.

Support System

Internal support system to turn, bend, squat was not observed in any of the cases. However, in several cases of simulation, it was observed that the participants either took the support of the wall, tap in the toilet (Fig.5.60 d), door, or the string inside the door (as an handle) (Fig.5.64 c) to balance themselves and put themselves in the squatting position. In one or two cases where there was a tap available in the toilet as a water source, the participant used tap as a support to rise up from the squatting position. This suggested the need of an internal system to be devised in a cost effective manner which could be held to balance and support the mobility impaired user. The possible alternatives as suggested by the respondents themselves were cast iron or bamboo pipe. They said, any other material as a support would not be within the affordability of villagers.

Ram Kishore (respondent no. 6) responded saying, "Family members provide me water while I go for toileting. I hold the wall (since there is no other way to support myself) to use the toilet. I leave my walking stick (mobility aid) outside the toilet when I am inside(Fig. 5.58 a,b). I find toileting a very cumbersome activity. "

Ravi (respondent no. 11) uses toilet with complete independence. He said, " I use door as a support to cross threshold. Being a frontal approach, I take the support of wall to turn around inside and use the toilet. I fill water on my own from the community hand pump located near my house. "

Floors

Floors of most of the toilets observed were either of mud, brick coba or cemented. Mud flooring would become swampy by the use of water while brick flooring was considered a better finish by the mobility impaired participants also. Mud flooring being soft, did

not hurt much in case of a mobility impaired person's fall on the ground while cemented floors (Figs.5.50 to 5.53)were expensive and also became slippery after water use. However, they did not require regular maintenance unlike other floors.

Seating System

Two types of seating system were observed during the survey, viz. a) brick /cement platforms as seats to squat (Figs.5.50,5.52) b.) Indian type w c seat (Figs.5.51,5.53). Being a rural low income community, not many choices were available for the seating types. Even though, the respondents also had awareness about the advantages of an ceramic Indian seat over the traditional seating system, the most common reason quoted was low priority in the socio economic condition. In the traditional seating system, the soil had to be manually cleaned while in the Indian sanitation pot, flushing with water would serve the purpose. In a case like Farhat's (respondent no.39), who had an amputated limb (and thus could not move beyond her house) had to defecate in her home in a space otherwise used for fodder storage (Fig.5.59).

The seating system also played an important role in either facilitating or hindering the transferring process of a non ambulant disabled person.

Water Support System

Being a wet system of toileting, water is needed for toilet flushing and personal hygiene. Though its availability inside the toilet was made through a bottle, jar or can carried by the user or another (uncommon) way in the rural setup was through piped water supply. The former was a more prevalent method due to its low cost. However, it was observed that in some toilets, water was kept at unreachable heights (Fig.5.52) which would make it even more difficult to access for a mobility impaired participant from squatting position. Though, it also accounted for a difficulty in carrying water while walking. The problem faced was even more if there was an assistive device (like

crutches, stick etc) in the other hand. Several respondents received water support through human assistance provided by family members.

Toileting in farms presents greater challenges for water support. Some of the respondents said, they take an empty container / bottle from home and fill it from the nearest hand pump on the way to farm, while others took a water filled container from home itself. The ordeals of going to farms for toileting can be understood through the following examples,

Neeraj Kumar (respondent no. 12), who has to go to farms for defecation, said, 'In rains, the trouble is even more. One hand on (water) container and one hand on my limb. Its quite troublesome.'

Rajender (respondent no. 27) said, "I get up at 4 am to go for toileting. Have to carry water over a distance on the uneven pathways. During rains it's a double trouble to carry an umbrella and a can of water."

Vinay (respondent no. 29) reported, " I have to go to farms almost half a kilometer away for toileting. An added task is to fill water on the way. It takes me almost an hour to complete the toileting process."

Safety

Safety, as a concern for the mobility impaired individual refers to the vulnerability of the persons with locomotor disabilities either due to falling on an uneven surface or slipping on wet surfaces etc. in the absence of any support system. Also, the concern for safety included danger from insect bites while defecating in farms. Following qualitative responses illustrate the safety issues from real life settings :

Pappu (respondent no. 30) goes out to farms for toileting .He said, " My feet get bruised especially in rains. Afterall, legs are the life of body. Sometimes, my tricycle over turns

while the wheel of my tricycle gets fixed in the soil. I often realize that I am handicapped."

Pinki (respondent no. 31) said, " While I used to go out for toileting, one more person (family member) accompanies to guard me. It used to take 30 – 45 minutes to do the complete activity."

Israr (respondent no. 38) was unable to complete the toileting activity on his own. His sister performed the role of caregiver who also said, " He takes almost an hour to do toileting. In winters, it will be even worse, as he won't be able to move at all.

Privacy

Privacy was a desirable need for almost all respondents for toileting activity, since it involves organs of personal hygiene etc. A walled enclosure with a door for opening is the most common form of privacy, but it was realized from the survey study that several toilets had no doors and few of the respondents also had to defecate in the open. Though, it is a common practice for other able bodied members of the community to use open fields for defecation, for a female member the choice of timings became a limitation. As a social culture prevalent in the area, women were not encouraged to go out for defecation in the open farms during broad daylight. Further, impaired mobility induced some constraints of undressing, etc. which took longer time to perform the activity than otherwise. Hence, privacy as a matter of concern became a more crucial factor for the family members owing to their vulnerability and the environment where they go for toileting. Even though almost all families displayed a very supportive attitude towards a disabled family member, in two cases where the mobility impaired person were of female gender, their mothers expressed a dejected response as care givers, due to other socio economic and family responsibilities inducing psychological pressures.

Some of the qualitative responses by female respondents highlight some other issues related to privacy.

Babli Devi (respondent no. 19) shared a fact that women are able to defecate under the screen of the crop, since there is no other way in open fields. She also highlighted that no women goes to farm after 6 AM."

Pinki (respondent no. 31) informed. "One more person accompanies me while I go to the farms for toileting. He keeps guard and ensures my privacy. It takes me around 45 minutes to perform the complete activity."

Shahzadi's (respondent no. 34) mother on the issue of privacy responded, " It is a major problem for her to do the basic ADLs. To what extent can I keep bolting doors for her."

Activity Analysis

Participants were asked to simulate the activity of toileting for a direct and better understanding in addition to the discussions held before and after. Photo documentation helped as a tool to document the process of performing toileting and highlights critical issues for gaining further insight from a design perspective. After categorization of qualitative data alongwith still photographs, typical cases were chosen to illustrate the issues related to the performance of the activity.

Case Study 1

Fig. 5.58 (a to c) show three critical steps related to accessing toilet in his home as simulated by Ram Kishore (respondent no.6). The first step shows that he keeps his walking stick (mobility aid) outside the toilet (Fig.5.58,a)and then he opens the battened door to enter in (Fig.5.58,b). It may be important to note the door height which is less than the height of the user. Fig.5.58 (c) highlights the 9 inches deep threshold that poses a barrier for Ram Kishore to cross while coming out.

Case Study 2

Vikas (respondent no. 1) simulated the complete process of toileting in his environment. Fig.5.60 (a) to (f) present the stage wise sequence of performing the complete activity of toileting. The first stage shows Vikas opening the toilet door inwardly Fig.5.60 (a) for frontal access. Low threshold is a facilitator for easy access for entering in (Fig.5.60,b).

In the third stage, he turns around (180 degrees) to position himself above the toilet seat and further sits over the seat in squatting position (Fig.5.60,c,d). After completing the defecation process, Vikas simulated to get up from squatting position to stand up by holding the tap at a low height (Fig.5.60,e), since there is no other internal support system. It is important to note that it was very rare to find a tap in the toilet in the rural environments of the study area. The last step to egress out is illustrated through Fig.5.60 (f) which is easily facilitated by the absence of a high threshold.

Case Study 3

This case study intends to highlight the issues of toileting related to a non ambulant participant who manoeuvred his ground mobility device to access and use the toilet. Fig.5.61 (a to e) illustrate the activity sequence as simulated by Raj Kumar (respondent no.2). To facilitate his reach to the toilet and indoor movement, Raj Kumar uses an indigenously created ground mobility device with bearings as wheels (Fig.5.61,a). A low threshold at the entrance facilitates his access while entering the toilet (Fig.5.61,b). A threshold level more than 2" high or low would have become a barrier to access. However, being a frontal approach and narrow width, Raj Kumar finds it difficult to manoeuvre his mobility device inside (Fig.5.61,c) to finally transfer on to the WC seat (Fig.5.61,d). The half closed door required adjustment to comfortably position himself for toileting. The last step illustrates Raj Kumar closing the door (5.61,e).

Case Study 4

This study documents the sequence of toileting activity process as simulated by Meera Devi (respondent no. 10). Before understanding the further details, it needs to be highlighted that this toilet cum bathing space was built by a local government agency in lieu of the "Below Poverty Line (BPL)" scheme for the poor. Though, it has added a toilet cum bathing facility in the respondent's house, who moves in squatting position (due to severe disability) with great difficulty, it still did not provide much ease as a solution. Fig. 5.62 (a) shows the respondent reaching the toilet door which opens outwardly and then entering through a brick platform in squatting position (Fig.5.62,b). Further, it highlights the battened door in closed position (Fig.5.62, c) and Fig.5.62 (d) shows the WC layout. For better understanding and clarity, the same set of toilet was documented using computer generated, virtual 3d model (Fig.5.63 a,b). It shows the step by step postural sequence of accessing the toilet. After a careful visualization, it was found that this layout required greater effort and two complete turns of 180 degrees (Stage 4 & Stage 7 as indicated in Fig.5.63 a&b) for the user to finally reach the required position for toileting. Also, there was no internal support to hold on while turning. Further, since the complete structure had only one access point, the user had to traverse through the bathing space for toileting and urination activity. It requires to be considered that the frequency of toilet use was more than the bathing space in one's daily routine. Further, the toilet did not have any water source for which she still had to depend on the community neighborhood since she lived with her old ailing father. Thus, toileting as a process on a daily basis became a cumbersome activity for Meera Devi. This was also due to her personal limitation of not being able to stand. However, it was observed and analyzed that it may require simple design considerations to improve access to such kinds of toilet designs (as discussed in design recommendations).

Case Study 5

Toileting for Israr (respondent no. 38) was also a challenging activity. Unlike able bodied persons, for whom it did not require much effort and thinking to perform it, for the

mobility impaired, it became a complete project with extra concerns of safety etc especially in cases with severe disability. Israr, depended majorly on his sister for majority of his daily activity needs as he had a poor mobility and balance. However, he simulated the process of toileting as he normally does in his daily routine. Fig.5.64 (a to g) sequentially illustrate the process of toileting as simulated by Israr. The first two photographs (Fig.5.64 a,b) show him reaching and accessing the toilet. Fig.5.64(c) shows him holding the jamb wall with one hand and pulling the string on the inner side of the door with the other to balance himself in squatting position and to screen himself from performing the activity. Fig.5.64 (d, e & f) show the sequential process of Israr coming out of the toilet. It also shows the 1'-3" high threshold crossing which was a tedious job for Israr with poor balance and no support. He labeled it as the most difficult part out of the total toileting process.

Though the above case studies, highlight specific cases of people with mobility impairments, using such facilities, the same toileting spaces were also being used by other (able bodied) family members. This remains true even while considering the design approach to develop model concepts.

Fig. 5.48 Brick paved ramp used by Vikas for reaching the toilet facility.

Fig. 5.49 Frontal approach toilet with Indian WC and bucket for water use.

Fig. 5.50 Frontal approach for a dry squat toilet with two cemented platforms to squat.

Fig. 5.51 Frontal approach for a squat toilet with an Indian WC seat.

Fig. 5.52 Side approach for a dry squat toilet with two brick platforms for squatting.

Fig. 5.53 Side approach for squat toilet with an Indian WC seat.

Fig. 5.54 Toilet with Indian WC and no threshold.

Fig. 5.55 Open fields used for defecation in the study area.

Fig. 5.56 Toilet with jute sack as a door for screening purpose.

Fig. 5.57 Toilet door made out of scrap iron.

Fig. 5.58 (a) Ram Kishore keeping his walking stick outside the toilet.

Fig. 5.58 (b) Ram Kishore entering the toilet.

Fig. 5.58 (c) Ram Kishore crossing the 9" low threshold to come out of the toilet.

Fig. 5.59 Farhat squatting in a corner space of fodder storage room at home for toileting.

Fig. 5.60 (a) Vikas opening the door inwardly to enter in the toilet thru' frontal approach.

Fig. 5.60 (b) Vikas entering the toilet.

Fig. 5.60 (c) Vikas standing on the footsteps of the WC

Fig. 5.60 (d) Vikas holding tap to position himself on the WC

Fig. 5.60 (e) Vikas in squatting position on the WC

Fig. 5.60 (f) Vikas moving out of the toilet.

Fig. 5.61 (a) Raj Kumar moving towards the toilet.

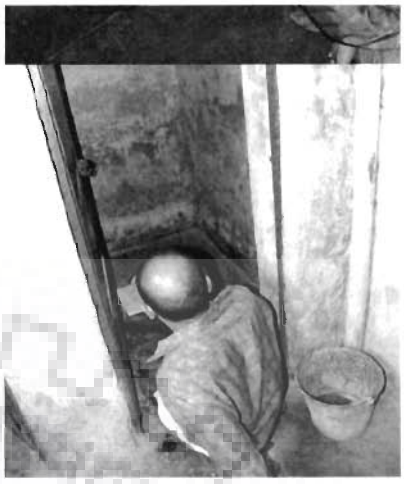


Fig. 5.61 (b) Raj Kumar entering through the toilet door.

Fig. 5.61 (c) Raj Kumar manoeuvring his ground mobility device to turn.

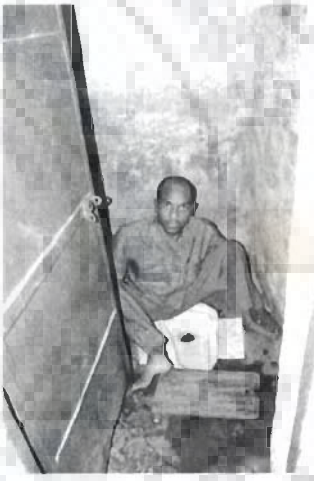


Fig. 5.61 (d) Raj Kumar transferred on to the WC from his ground mobility device.

Fig. 5.61 (e) Raj Kumar closing the toilet door.

Fig. 5.62 (a) Meera Devi entering toilet in squatting position.

Fig. 5.62 (b) Meera Devi entering closing the toilet door.

Fig. 5.62 (c) Battened Door of toilet in closed position with no fixtures on outside surface.

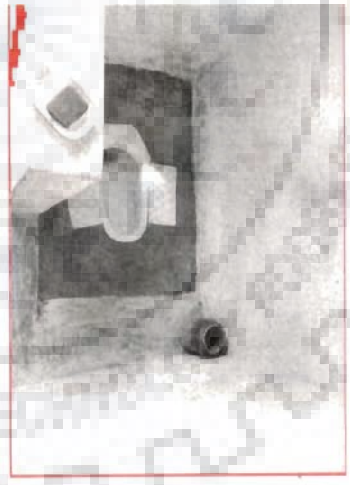


Fig. 5.62 (d) Indian wc seat as positioned in Meera Devi's toileting space.

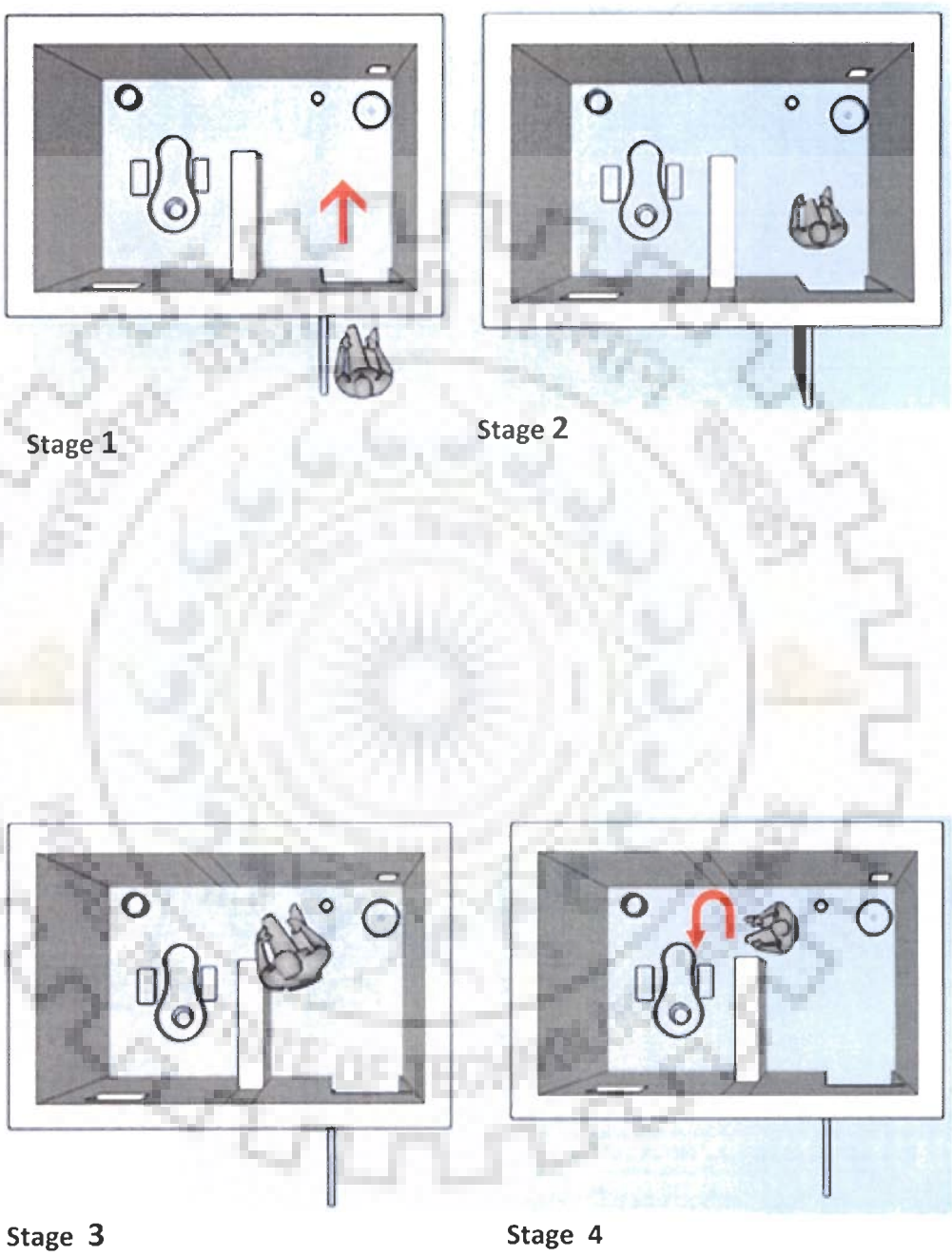


Fig. 5.63 (a) Simulating stages 1 to 4 of movement by Meera Devi through the toilet

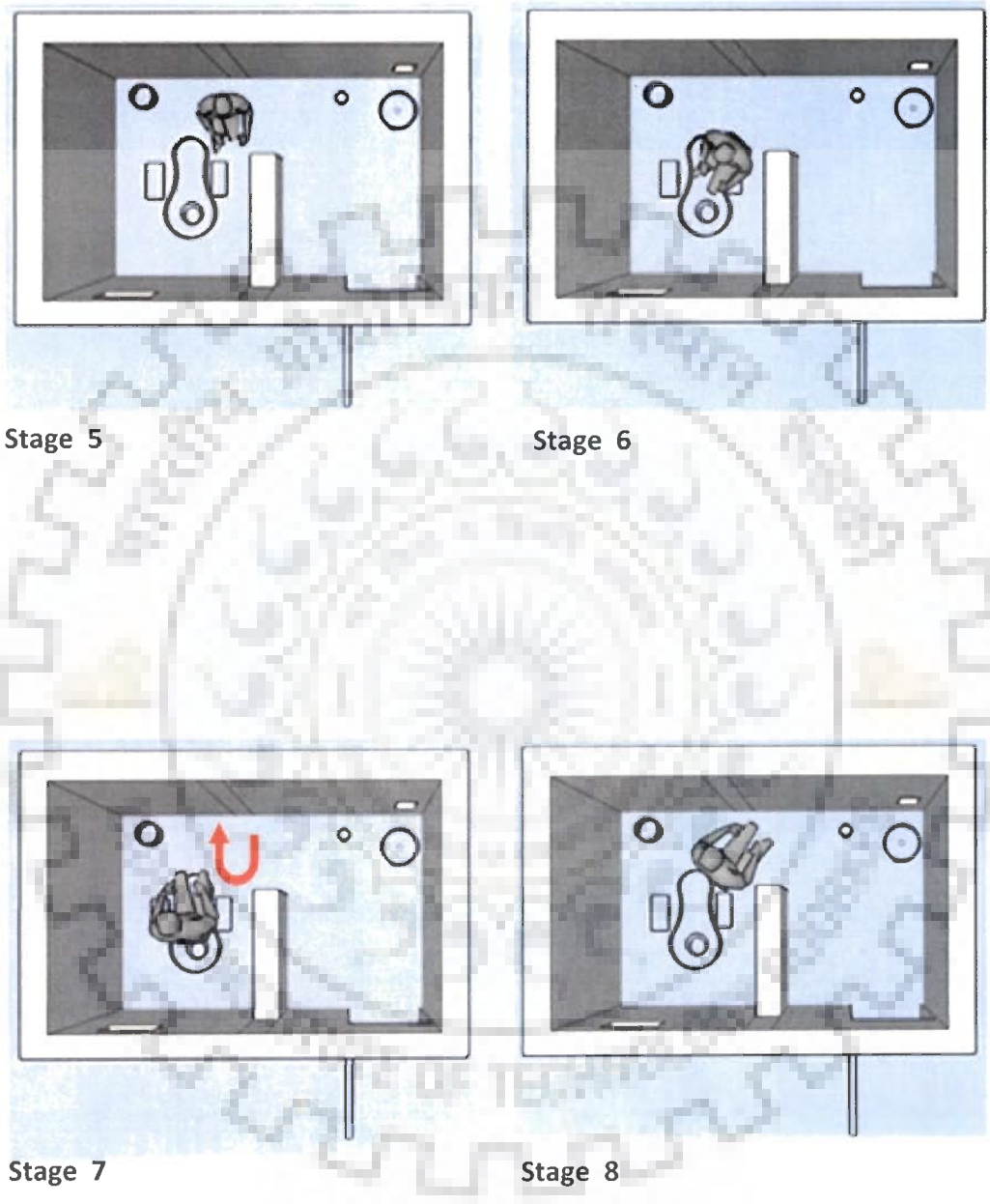


Fig. 5.63 (b) Simulating stages 5 to 8 of movement by Meera Devi through the toilet

Fig. 5.64 (a) Israr moving towards the toilet.

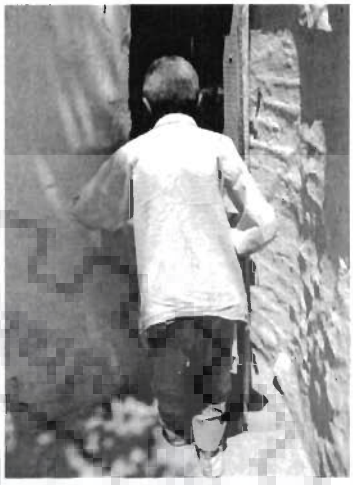


Fig. 5.64 (b) Israr entering the toilet.

Fig. 5.64 (c) Israr holding wall with one hand and pulling string to close the door from inside.

Fig. 5.64 (d) Israr opening the door in squatting position.

Fig. 5.64 (e) Israr coming out of the toilet.

Fig. 5.64 (f) Israr squatting down to wash hands.

Fig. 5.64 (g) Israr holding wall for support while moving out of the toilet.

5.5.3 Bathing

Bathing refers to the act of body cleaning and sanitation using water as a prime element. Taking bath as an activity of self care forms an integral part of one's daily living in the region of study. Activity simulations and insights shared by the survey participants and other members of the village community facilitated the understanding of issues related to bathing activity from a perspective of persons with mobility impairments. During the survey, many bathing sites within and outside the home were visited to familiarize oneself with their environment. Rural environments reflected a very informal character in bathing spaces. Not all respondents have a designated private bathing space. Many of them took bath under a hand pump in the open, whether in the house courtyard or on the community hand pump. Before understanding the various parameters that affect the bathing criteria, it would be apt to know the perceptual experiences of the mobility impaired subjects under investigation.

Fig. 5.65 shows the frequency distribution of the Perceptual Experience Rating as given by the survey respondents. It shows that as many as 23 respondents found bathing as a difficult experience with 5 (12%) of them rating it as very difficult and 18 (42%) of them rating it as difficult. 19 (44%) subjects experienced bathing as neither difficult nor easy while only 1 (2%) respondent experienced a little ease in performing bathing as an activity. The diversity of responses also had a great factor of the person's adaptability. As was otherwise seeming difficult to the observer, many respondents shared the fact that they are used to performing this activity that way. However, they admitted that they had an experience of difficulty relative to the able bodied persons but they had no other choice but to adapt to the existing conditions.

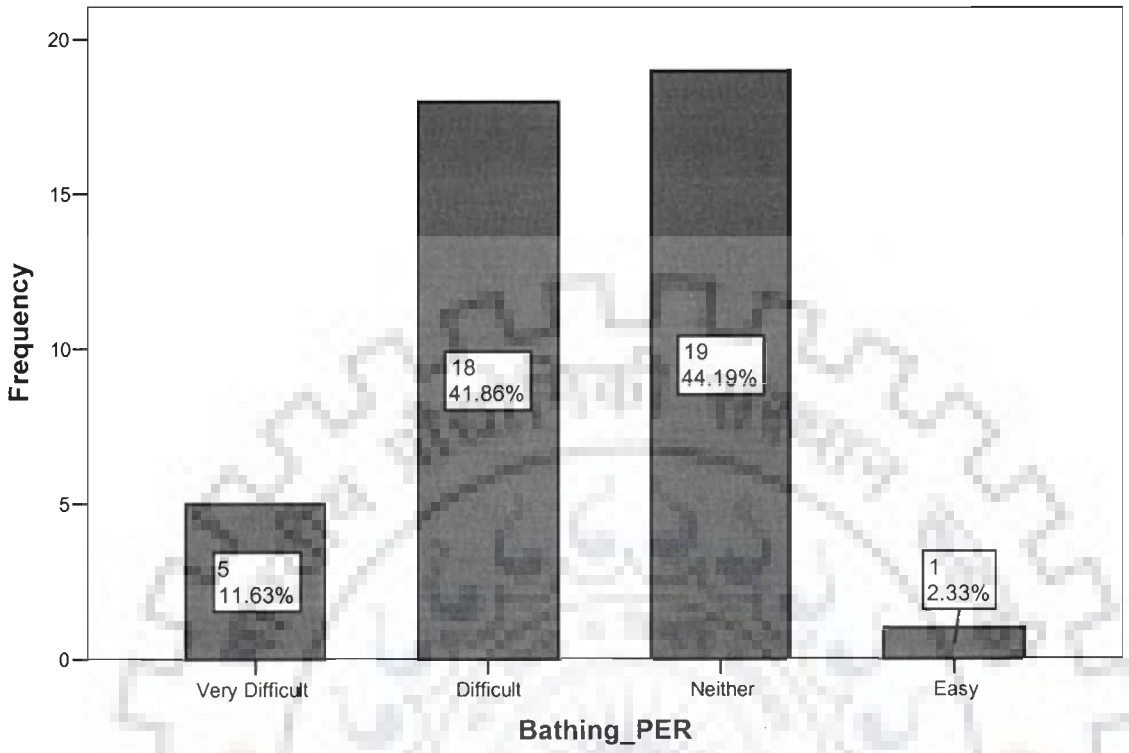


Fig. 5.65 Bar chart showing frequency distribution of Perceptual Experience Rating for Bathing activity by survey respondents.

Further, crosstab analysis was conducted between the disability type and the Perceptual experience rating for bathing. It reveals through Table 5.13 presented below that ambulant disabled subjects had a wide range of experience for bathing activity with 11(26%) of them rating some sort of difficulty in performing it while 19 (44%) of them rating their experience as neither difficult nor easy and only 1 (2%) person reported performing bathing activity as an easy task. Amongst the non ambulant category of subjects, 4 (9%) of them rated their experience as very difficult while the rest 8 (19%) responded to their experience as difficult. Performance of activity by non ambulant disabled was perceived to be more difficult as compared to the ambulant disabled.

Table 5.13 Disability Type * Bathing_PER Crosstabulation

			Bathing_PER				
			Very Difficult	Difficult	Neither	Easy	Total
Disability Type	Ambulant	Count	1	10	19	1	31
		% of Total	2.3%	23.3%	44.2%	2.3%	72.1%
	Non Ambulant	Count	4	8	0	0	12
		% of Total	9.3%	18.6%	.0%	.0%	27.9%
Total		Count	5	18	19	1	43
		% of Total	11.6%	41.9%	44.2%	2.3%	100.0%

Another crosstab was generated to understand the distribution of the distance perceived by the subjects under investigation and their perceived experience of bathing activity. It is presented in Table 5.14 which shows that most of the respondents (35) took bath in their own house while the rest 8 took bath outside either in the neighborhood or at some distance away from the home. The respondent who rated his perceptual distance as quite far from the house, also rated his bathing experience as very difficult. It is interesting to note that out of 7 participants who perceived their bathing space near to their house rated 4 of them experience difficulty in one way or the other in performing the activity. 3 out of those 7 reported their experience as neither difficult nor easy. Also, amongst the ones who performed bathing within their home environments, 3 reported bathing as very difficult and 15 of them said it to be difficult in some way. 16 of them shared their perception of neither difficult nor easy while only 1 of them felt it to be fairly easy to perform.

Table 5.14 Bathing_Perceptual Distance * Bathing_PER Crosstabulation

			Bathing_PER				
			Very Difficult	Difficult	Neither	Easy	Total
Bathing_ Perceptual Distance	In the house	Count	3	15	16	1	35
		% of Total	7.0%	34.9%	37.2%	2.3%	81.4%
	Near the house	Count	1	3	3	0	7
		% of Total	2.3%	7.0%	7.0%	.0%	16.3%
	Quite far from the house	Count	1	0	0	0	1
		% of Total	2.3%	.0%	.0%	.0%	2.3%
Total		Count	5	18	19	1	43
		% of Total	11.6%	41.9%	44.2%	2.3%	100.0%

The above results show that despite proximity of the space to perform bathing activity, some of the mobility impaired participants experienced it as very difficult and difficult. Though, it would be difficult to point out a single largest factor impacting their perceptual response, it is evident that a complex interaction between various personal and environmental factors led to one's perception. Proximity of the space facilitates reach of an individual to the place of activity and hence becomes one of the imperative factors for consideration. It was also realized that mobility devices facilitate one's mobility to some extent if not completely. Thus a crosstab analysis between the type of mobility device in use and the perceptual experience was done as presented below in Table no. 5.15. It shows that all persons who used wheeling device for mobility experienced some sort of difficulty in performing the activity. Amongst 4 crutch users, 3 of them also perceived their experience as difficult while 1 among them rated it as neither difficult nor easy to perform. Interestingly, all stick/cane users experienced bathing activity as neither difficult nor easy while amongst the ones who did not use any mobility device, 4(9%) found it very difficult and 12 (28%) found it difficult while 11(26%) rated their experience as neither difficult nor easy and 1(2%) of them rating his experience as easy.

Table 5.15 **Mobility Device * Bathing_PER Crosstabulation**

			Bathing_PER				
			Very Difficult	Difficult	Neither	Easy	Total
Mobility Device	No Mobility Device	Count	4	12	11	1	28
		% of Total	9.3%	27.9%	25.6%	2.3%	65.1%
	Stick / Cane	Count	0	0	7	0	7
		% of Total	.0%	.0%	16.3%	.0%	16.3%
	Crutches	Count	0	3	1	0	4
		% of Total	.0%	7.0%	2.3%	.0%	9.3%
	Ground Mobility Device	Count	0	1	0	0	1
		% of Total	.0%	2.3%	.0%	.0%	2.3%
	Wheelchair	Count	0	1	0	0	1
		% of Total	.0%	2.3%	.0%	.0%	2.3%
	Tricycle	Count	1	1	0	0	2
		% of Total	2.3%	2.3%	.0%	.0%	4.7%
Total		Count	5	18	19	1	43
		% of Total	11.6%	41.9%	44.2%	2.3%	100.0%

Qualitative Analysis

Qualitative investigations through discussions in a semi structured format alongwith activity simulations led to further understanding of issues related to bathing activity. Bathing was usually performed in two types of locations viz. a.) in an enclosed space in home b.) under the hand pump (at home or at community level). Both systems of bathing have their own merits and demerits as observed and analysed through this study. A number of bathing facilities were observed which enabled the bather to sit comfortably next to a water source and use it.

Reachability

Proximity

Location of bathing space in terms of the distance to be traversed by the mobility impaired subject was an important parameter to decide one's reachability. Since mobility was a limiting feature, the closer the bathing facility, the better it was. Table 5.14 as discussed above shows the details of the perceived distance of bathing facility by the survey participants. Though, most of the respondent's houses had either a designated space (fully or semi enclosed) (Fig.5.69) for bathing or the hand pump space in the open courtyard of the home was used for multipurpose activities. However, in a particular case, it was observed that the survey subject (Rekha Rani, respondent no. 9) used to climb up the terrace (for privacy) through stairs to take bath, since there was no enclosed space in her space below. She was dependent on other family members for water as a need. The farthest distance that one traversed for bathing was almost 500 feet and that was in the case of Muntazeer (respondent no. 14) who went to the nearby mosque to use the bathrooms constructed there for community use.

Accessibility

Similar to the toileting activity as discussed previously, the factors that controlled the degree of accessibility in bathing were thresholds, the doorway and approach to the bathing space and the spatial typology.

Thresholds

Bathing space is usually categorized into a wet space wherein thresholds were considered an important element to check water spilling outside the bathing space. However, if they exceed the climbing range of the mobility impaired users, it became a barrier to the access. For example, as observed in the case of Shahzadi (respondent no. 34), who reported great difficulty in accessing her bathing space due to a 1'-9" down threshold (Fig. 5.83 b,c). In an open space with hand pump as a water source, a deep threshold was also pointed out as a barrier by Mukul (respondent no. 35).

Doorway and Approach to bathing space

The approach to bathing space was considered a function of the spatial typology of the bathing area. In case of an open hand pump space, it could be approached from either of its two sides. The side with minimum obstructions in its route (like degree of unevenness of the path) was chosen for a comfortable approach by the survey participants. Semi enclosed spaces with walls upto a 4'-0" height had one of its edges left open for accessing the space. While fully enclosed spaces for bathing had a doorway usually of a narrow width ranging between 2'-0" to 2'-9". Having a wooden door was a common option (Fig.5.78) but not all respondents could afford it. Several bathing spaces in the respondent's homes were seen where a cloth hung over a rod or a rope was used in lieu of a door for the purpose of screening (Fig.5.75 to 5. 77).

Usability

Usability as a criteria helped to understand the various other aspects of a bathing space including its spatial typology, internal dimensions and layout, flooring, internal support system and the water source. These issues are discussed under separate headings as follows :

Space typology

Four types of spaces were observed where the survey participants commonly performed the bathing activity. Fig. 5.66 shows the distribution of survey participants based upon the type of space where they took bath. Out of 43 survey participants with mobility impairments, 15 (35%) of them took bath in the open space (with and without a water source)(Fig.5.67, 68) in their dwellings while 18(42%) of them used an enclosed space in their homes with no direct water source in that space. 4(9%) participants used an enclosed space in their homes with a direct water source while 6 (14%) of the subjects went to the community hand pump to take bath. The quality of space provided for bathing had an impact on the ease or difficulty of performing the activity. However, it is important to note that taking bath (for men) in open under a hand pump as a water source was observed to be a common phenomena in the study area.

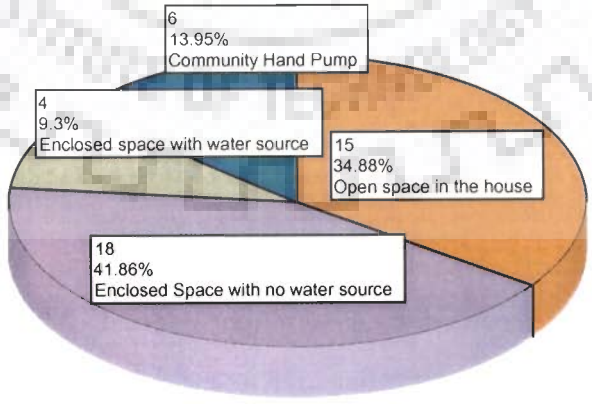


Fig. 5.66 Pie chart showing frequency distribution of type of bathing spaces being used by survey participants.

Internal Dimensions and Layout

There was no uniformity in the sizes of bathing spaces in the study area as they were not directly made on site as per their understanding and the space available in their houses. Their internal dimensions of enclosed bathing spaces were of diverse sizes like 2'10" x 3'-2", 2'-10" x 3'-6", 3'-0"x 4'-2", 3'-3"x 4'-0", 3'-8"x 4'-7". The layouts were majorly rectangular in shape. However in open spaces of bathing, the dimensions suggested a spacious layout.

Flooring

Most spaces observed during survey had a cemented floor or a brick coba finish. Cement floor was considered good for its easy maintenance and it suited the purpose of bathing and washing activities which could not be done on a brick or mud floor. However, ones who could not afford a cemented floor for bathing space used a large stone piece for the purpose of bathing and washing. The participants however agreed on the fact that cement flooring was quite slippery when wet.

Water Source

Location of a water source was a critical issue for deciding the need for human assistance by the mobility impaired subjects. Direct availability of a water source in the bathing space promoted independent functioning while its location beyond the bathing space made the person with limited mobility fetch water in a bucket from the source or depended upon a family member for water. It was observed through the simulations of activity performances that a right angled configuration between the hand pump handle and its outlet was considered quite convenient for access and use (Fig.5.72). Other configurations between the hand pump handle and outlet (i.e. both on the same side or both at an angle of 180°) had limitations for direct use by mobility impaired participants as it required one person to operate the handle while the person at the outlet could use the water for desired use. Also, it was observed that some hand pumps required greater

effort to pump water while some of them were operable with less effort. It was thus found that hand pumps with longer handle not only required lesser effort but also facilitated use in sitting position. Piped water supply, was however considered an option which facilitated high degree of ease in its use.

Internal Accessories - Clothes Hanging, soap keeping

Hooks as supports to hang clothes after undressing or for dressing was a possible option available only in bathing spaces with an enclosure of walls around. A dry space to keep soap was also considered a desirable element if not necessary in the bathing space. In open spaces around the hand pump, soap etc. were kept either on a piece of stone in a corner or in a niche created in the wall. (Figs.5.79 to 5.81)

Internal Support to Balance while undressing

Another observation through the survey was that the participants encountered a problem in lowering their bodies and in getting up from sitting postures after the completion of the bathing activity. Most participants said, they either took the support of the wall or floor to manage their postures and risked slipping during the process due to weak balance. In case of an open bathing space, hand pump itself became a supporting element in the environment to provide postural support (Fig.5.74).

Privacy

Privacy was yet another important criteria for bathing as an activity of personal hygiene. Doors in walled enclosures were the most common way to screen oneself while bathing. Though, in quite a few cases with enclosed spaces for bathing, door was not an available option. A cloth piece hung over a rod or string functioned as a curtain to screen the bathing activity. This was an alternative derived out of low affordability by the family. However, open spaces with hand pump as a water source or no water source available were used directly by male members of the family for bathing. Female participants had devised an indigenously prevalent option of using cot as a screening device in standing position.

While much insight was gained through personal discussions with the respondents and physical study of their environments where they performed their activity. Participants also simulated the bathing activity in their home environments which is presented in the form of case studies to highlight the bathing process and the steps involved, as typical examples.

Case Study 1

This case study documented through photographs from Fig. 5.82 (a to e) shows, Vikas Kumar (respondent no.1) using an enclosed bathing space. Fig.5.82(a) shows Vikas crossing the threshold (6" high) to enter the bathing space while holding the jamb wall for support. To lower down his body for a bathing posture, Vikas holds tap as a supporting element (Fig.5.82,b). Further he squats down for bathing (Fig.5.82,c) as a third stage of the activity. He lifts the bucket and then moves out of the bathing space after completion of the activity (Fig.5.82,d,e).

Case Study 2

It highlights the sequential documentation of Shahzadi (respondent no. 34) about accessing the bathing space in her home. It is important to note the difficulty of climbing down the threshold (1'9") on a daily basis for performing bathing as an activity (Fig.5.83,b,c). This requires the help rendered by a family member (mother or her younger sister) to assist by holding her crutches outside while she transfers down the level. Since, there is no water source inside the bathing space, Shahzadi has to depend on human assistance for that too. Her mother told that she cannot do her work independently to the extent that she cannot even bathe completely without assistance. Shahzadi's mother further informed that she washes her head to aid in the bathing process.

Case Study 3

Sonia (respondent no.24) is a non ambulant disabled who crawls to move in the absence of any mobility device. Being from a very poor family, there was no exclusive bathing space in her home. As observed, she took bath in an open space in the home which was also used to wash clothes and clean utensils. Since there is no water source, she depends on her family members to provide water for the desired activity. Also, for screening, sleeping cot in her home is used for the purpose. To further improve privacy her family members put a cloth sheet over the cot (Fig. 5.84 b,c).

Case Study 4

Sattu (respondent no.18) also belongs to the non ambulant category of disability who finds the activity of bathing as very tedious and cumbersome. Since, he is unable to manage it independently, his mother shared her feelings about future concerns of managing basic activities. Fig.5.85(a) shows Sattu trying to reach the bathing platform over a high edge. The bathing space has a hand pump towards the end where Sattu sits to simulate his bathing posture (Fig.5.85,b). Also, one finds a niche made in the brick wall at a very low height to keep soap and other accessories used for bathing/washing. Its low height facilitated an easy access while grooves in the brick wall were used for keeping other accessories like tooth brushes etc. in the absence of any other storage shelf (Fig.5.85,c). Sattu had other limitations that he could not lift bucket nor could he walk or stand. Also his knees got bruised while crawling on hard floors. Many a times as reported by his family members, he was lifted in the arms by his brother who used to place him on the bathing platform for further performing of the activity.

Fig. 5.67 Cemented platform as bathing space near the entrance of the house.

Fig. 5.68 Plinth outside the house used as bathing space.

Fig. 5.69 A semi enclosed bathing space with no water source.

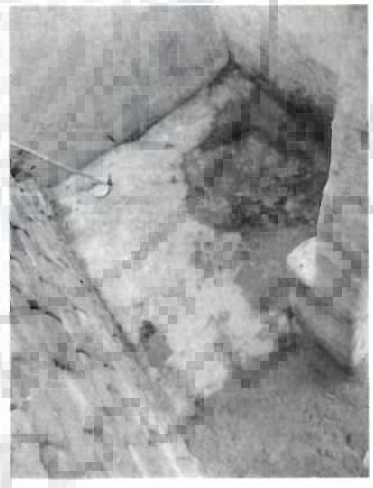


Fig. 5.70 Bathing space enclosed from all sides with no water source inside.

Fig. 5.71 Rakesh standing over a swampy ground to fill water from a handpump for bathing.

Fig. 5.72 Ram Kishore using a handpump with 90° configuration between handle and its outlet in his bathing space.

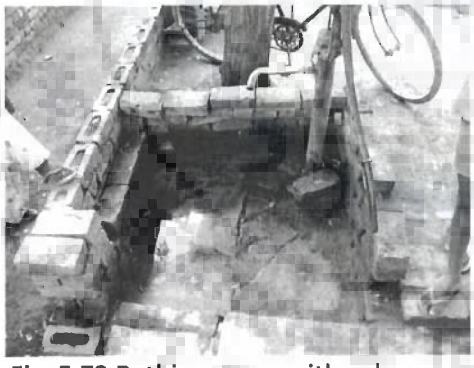


Fig. 5.73 Bathing space with a deep threshold and hand pump in corner as a water source.

Fig. 5.74 Sandeep holding handpump as a supporting element to sit in bathing position.

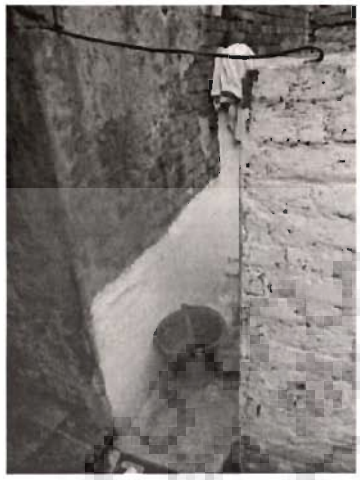


Fig. 5.75 Bathing space with a rod over a narrow doorway for hanging cloth as a screen.

Fig. 5.76 Bathing space in use with a curtain over a string as a low cost alternative to door.

Fig. 5.77 Bathing space with a sheet of cloth being used as a door.

Fig. 5.78 Wooden door of a bathing space with a small chain hanging outside for pulling the door outwards and bolting it.

Fig. 5.79 Corner slab to keep soap etc. at 4'0" height in a bathing space.

Fig. 5.80 Niche for keeping bathing accessories at a low height for easy access

Fig. 5.81 Hooks to hang clothes on the front wall of the bathing space with no water source.

Fig. 5.82(a) Vikas kumar crossing threshold to enter the bathing space.

Fig. 5.82(b) Vikas kumar sitting down using tap as a support element.

Fig. 5.82(c) Vikas kumar squatting down to show bathing posture.

Fig. 5.82(d) Vikas kumar lifting the bucket while holding wall for support.

Fig. 5.82(e) Vikas kumar crossing threshold to move out of the bathing space.

Fig. 5.83(a) Shahzadi moves in bending posture to reach the bathing space.

Fig. 5.83(b) Shahzadi crossing threshold 1'9" below to enter bathing space.

Fig. 5.83(c) Shahzadi folding her impaired lower limb with her hand after crossing the threshold.

Fig. 5.83(d) Shahzadi sits inside the bathing space in squatting posture.

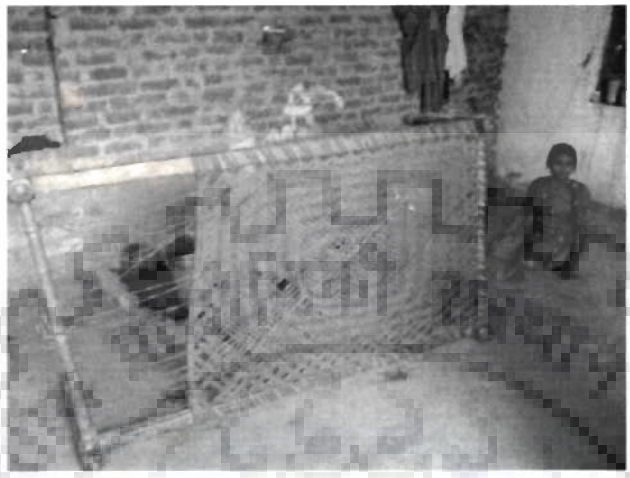


Fig. 5.84(a) Sleeping Cot being used as screening device for an open bathing cum washing space in Sonia's residence.

Fig. 5.84(b) Sonia simulating cleaning activity in the bathing space,with no water source, as seen from the front.

Fig. 5.84(c) Sonia simulating cleaning activity in the bathing space while using cot to screen the activity, as seen from the back.

Fig. 5.85(a) Sattu trying to climb up the threshold of the bathing space.

Fig. 5.85(b) Sattu seated near the hand pump in the bathing space in his home with a storage niche at an accessible height.

Fig. 5.85(c) Grooves in the wall being used as storage space

5.6 OCCUPATIONAL ACTIVITIES

Rural environments have a different scale of life when compared to an urban scene owing to several socio cultural factors. Contrary to the researcher's assumptions, the rural people in the study area were found to be quite aware and conscious about education. However, not all of them were able to continue it beyond primary or high school level. With a lot of awareness through media and other sources, a drastic shift in the thinking of the rural people was observed. Low levels of literacy and agriculture as an occupational activity used to be the trends till the early 1990's. However, in the context of this study the focus was to know about the various occupational activities of the mobility impaired persons. Fig.5.86 shows the distribution of survey participants based on their occupation types. 18 (41.34%) respondents were engaged in education (studying) as an occupation activity which included either primary school, secondary or private courses from the town. 13 (30%) respondents were engaged in some sort of self employment which included professions like tailoring, grocery shop etc. 7 (16%) respondents had no occupation to engage themselves. They used to be either idle in their homes or could be located on a village centre or around a barber's shop where gossip sessions and local politics used to be discussed. The number of individuals involved in household work ranged from 5 to 10, since girl participants in the survey who were otherwise involved in studying also contributed a lot to the house hold work. No male member was found to be contributing to that domain, as was a socio cultural practice.

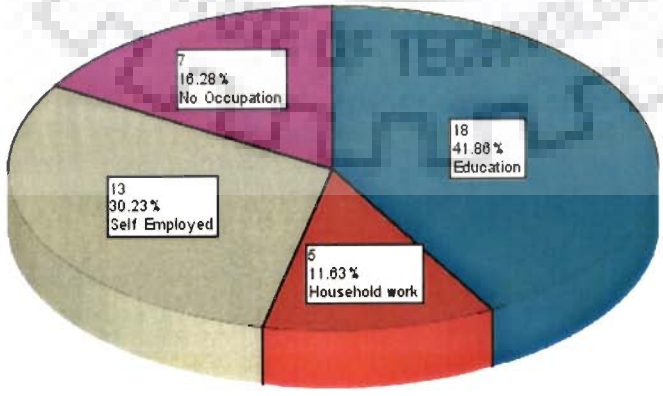


Fig. 5.86 Pie chart showing the Frequency distribution of survey participants based on the Type of Occupation.

5.6.1 Education Based Activities

Though, Indian villages characterize low education levels, the need of education was quite strongly felt by the survey participants and their family members. It was interesting to note that many of the participants who were under the age of 20, showed some curiosity for education. Most of the participants in the school age group, were engaged in some or the other educational activity. There were five respondents who had discontinued going to school as it was only till the primary level in the village and for further education, they would have to go to town which was quite far and thus out of reach. Only two villages (Sherpur and Padli Gujjar) had a primary school and one central school (upto intermediate level) was located near another village of Bhangeri Mahavatpur. Access to educational facilities was observed to be a major concern as was pointed out by several respondents who had great difficulty in reaching the school or had to depend on family members and friends for this purpose. Two female respondents had dropped out of school due to greater distance and lack of mobility resources.

Some of the issues listed out as barriers by two mobility impaired participants who went to the government school were viz. a.) Location of classroom on the upper floors b.) Inaccessible toilet and drinking water facilities c.)Lack of Teacher's support.

Fig.5.87, 88 show two different images of a primary school in a village in the study area. It is important to note that one of the school buildings had got a ramp also built, though its very steep with pillars as obstructions in the side which hold the grab rails. Also, it shows a drinking water facility (handpump) in its premises. With high grass and uneven ground around the hand pump, it becomes difficult for the users with mobility limitations to access it (Fig.5.89). School toilets were also observed to be inaccessible.

It was thus observed during the survey investigation that on one side there was an apparent gap in the policy to make built environment accessible and the implementation practices which in the absence of proper guidelines get executed in wrong ways. Also, it was found that such inaccessibilities in the environment got created as a result of

attitudinal and social constructs. However, there lies a great scope to make education accessible to diverse disability groups in the rural low income environments. To further understand the social scenario, the qualitative responses of participants are presented below:

Shahzadi's (respondent no. 34) father who by himself was a labour showed a great concern for his daughter's education. He told, " I had gone to several schools in town for Shahzadi, but they are neither ready to give concession in fee and nor is there any facility to go that far. A tricycle rickshaw charges Rs.400/- per month for that distance which would be too high an expenditure beyond the school fees for us to afford." He further expressed his feelings about education by saying, " Education is very necessary. An illiterate man, even if is a millionaire, is useless. If we are eating two chapattis in a meal, I may eat one to save money for her education."

Pinki's (respondent no. 31) family informed, "Education was available in the village only upto class 5th, so she could study only upto that. There's no vocational training available nearby. Had there been no economic constraint, she would have been educated. Could've got a diploma and job too."

Sagar's (respondent no. 28) mother reported " It takes almost half an hour to walk down to school. He takes support and rest in between, while walking to the school. Callipers were good in support initially, but later on he used to feel uncomfortable wearing them. But, in Government school, there is no care, I wish to send him to a private school."

Raj Kumar (respondent no. 2) resumed his studies at the age of 24 by joining a computer course in the town. He used to commute on his motorized tricycle which his father had purchased in Rs.20,000/- for him. His curiosity to study and then do some job was an eye opening revelation of his dreams.

Ravi, who also goes to school felt disturbed by his friends remarks saying, " How long would we continue to help you by transporting you?" Owing to such remarks, it pulled down his morale.

Fig.5.87 Primary School building in village Sherpur of the study area.

Fig.5.88 Primary School building with a ramp in its front.

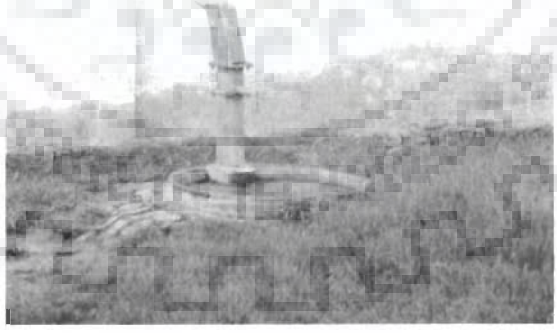


Fig.5.89 Hand pump space for drinking water in the village school.

5.6.2 Employment Based Activities

In most cases, members of the family contribute to the household economy by working in some form or the other. There is often little or no money for the expensive medical treatment and disabled family members are often left to their own care. Perhaps because of this, gaining employment was seen as the primary aim for many of the participants. Limited mobility critically affected their employment opportunities which were considered normal for the rural community, like labour in the nearby farms, construction works in the town or to work as industrial labour. Since, mobility impairments also led to some kind of reduction in their physical strength due to pain, jobs requiring mobility were automatically ruled out. Employment based occupation was considered a domain of men, unless the need was too critical to involve female member's contribution to the household economy.

It was observed that most men with mobility impairments were engaged in self employment activity. Five men were engaged in tailoring as a source of employment in their respective villages, while two of them had grocery shop in their homes (Fig.5.93). One of the respondents had a cycle repair shop (Fig.5.92). All these jobs required long hours of sitting and were hence preferred by the persons with mobility impairments. There were two female members also who occasionally stitched clothes to contribute to their household income. While one female respondent practiced as a beautician for local marriages in the village. This was also an occasional activity. Only one respondent out of 43, had received a vocational training in tailoring from a polytechnic in the town. This training, he had received under the Vocational Rehabilitation programme offered by the Government. After the training, he also got a support of Rs.5000/- as loan to buy a sewing machine and start his tailoring activity as a source of employment (Fig.5.90).

An employment activity was deemed necessary, not only for contributing to economic sufficiency but also as an activity of engagement of mind. Sitting idle with no contribution either economic or social, was felt like a burden in their minds. It was evident from the cases of two respondents with mobility impairments, who had no source of employment.

While, one of them aspired to make furniture at home, he did not have enough money to start his work. The other used to sit in the farms on his tricycle as a pass time. Both the members suffered from depression with a feeling of being a burden on their family members. It was also clearly observed while discussing with the survey participants that all members surveyed who were in the age of being employable possessed a very high sense of dignity which was expressed as their aspiration to learn some skill and then earn.

For example when *Sonia (respondent no. 24) was asked what would improve her quality of life, she responded that owning a sewing machine would improve her living quality of life, because she could then earn a living for herself.*

While Raj Kumar (respondent no. 2) at the age of 27 was still trying hard to study (computer course in a private institute in town) with the hope to get some employment.

Generally, all participants conveyed a positive feeling about the community support. For example, Pankaj (respondent no. 4) who ran a grocery shop said, "I take support from local children to sometimes pick a thing from a shelf at higher level. "

Mujammeel Ahmed (respondent no. 40) informed that, "My shop is a meeting point for most villagers. So, it also keeps me engaged in discussions with them while running my shop." (Fig.5.93)

Only one participant complained of a bad attitude of community members with respect to paying for a job.

Momin Ahmed (respondent no. 17), who also stitched clothes at home, informed that people cheat him when it comes to payments. He said, "They bargain so much that I am unable to eke out my livelihood."

Fig.5.90 Sandeep on his sewing machine bought as a part of vocational rehabilitation programme.

Fig.5.91 Momin Ahmed stiching clothes as a source of earning at home.

Fig.5.92 Ganga Ram on his cycle repair shop.

Fig.5.93 Mujameel Ahmed running his grocery shop.

5.6.3 Household works – Cooking, Cleaning utensils, Washing clothes

Household chores have always been an integral part of household activities generally as a socio cultural practice dominated by female gender. It is almost an expectation for the women to be taking a role in performing household jobs. Household chores involved a series of activities like cooking, cleaning utensils and washing clothes. It was difficult to quantify and measure the degree of difficulty in doing such roles. However, through a set of personal discussions from the semi structured interview and a personal understanding through the photo documentation process, the following discussions emerged. These areas were generally not of much concern to male members of the family.

Cooking

All household works as being performed by most respondents were seen to be carried out at the ground level. The most important activity being cooking, on which the rest of the family members depended for their meals, was carried out on chulha, wherein the fuel (wood, dry leaves) was ignited and the vessel with the cooking material was kept on the top of the chulha. Chulha was usually observed to be made of earthen clay and located centrally in the courtyard. Most female respondents performed the activity of cooking in squatting or cross legged sitting position. Although, squatting was the usual posture to perform cooking activity, not all (female) respondents who cooked were able to perform it in that posture. Some of them had to either straighten the leg or use a cross legged posture to complete the activity.

Pain in the limb was commonly observed as a limitation to adjust postural changes. So, once they sat down for cooking activity, it had to be ensured that all the materials were within their reach else they had to depend on human assistance. Assistance by younger members of the family like children was considered to be a positive attribute of the culture as it induced passive learning in the minds of the child and also was considered as a matter of respecting the elders. Most respondents used a very low height wooden stool to comfortably seat for cooking (Figs.5.95 to 5.98).

The issues observed were, that not many respondents had a kitchen or a store to keep the edible material safely. It was found that only one respondent had a LPG connection to cook on a gas stove yet the cooking activity was held at ground level only (Fig.5.98). Storage of utensils, cutlery and edible materials (dry, wet) was of great concern among respondents who were non ambulant. As it was difficult to store all materials on the ground. A ground mobility device could be of great help in such cases. During rains, it required to either shift the cooking chulha etc in the verandah which had a roof to shelter the chulha from getting wet.

Babli(respondent no. 19), felt that she had to keep her crutch along the wall support and take the support of wall to sit down. There were many other cases, where space to keep the assistive device like crutches, stick etc. was a problem.

Sonia, (respondent no. 24) did all household works including cooking. Her mother worked as a maid while father worked as a labour in the town. She told that she had difficulty in squatting and had to perform all household chores since morning.

Meera Devi (respondent no. 10) could not sit in cross legged position to cook.

Shahnaz(respondent no.37) had to cook with her straightened leg.

Floor Laying / Cleaning Home

Floors were usually mud, brick or cemented. Mud floors were difficult to maintain and clean since the space was meant to cook and use things, which would affect oral hygiene. It required floor relaying after a regular period in case of mud which in itself was a very tedious job, in contrast to the cemented floors which were much easy to clean and maintain.

Fig. 5.94 Shahnaz using chulha for cooking with straightened leg.

Fig. 5.95 Farhat placing her wooden stool to sit before the chulha.

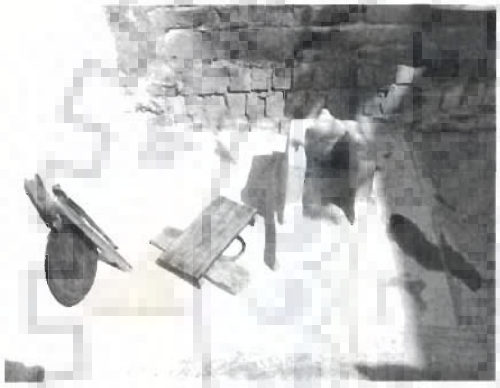


Fig. 5.96 A typical rural kitchen setup with mud floor and chulha.

Fig. 5.97 Babli placing her crutch along the wall while bending to sit on the stool for cooking.

Fig. 5.98 Sushma sitting on wooden stool for cooking on LPG stove at ground level.

Fig. 5.99 Meera Devi drying wheat grain in her home at ground level.

Cleaning Utensils and Washing Clothes

Cleaning utensils and washing clothes are two different activities as a part of the household work domain. Despite the difference in the timings of performing the above two activities, a single allocated space served the purpose for their performance. A space with water facility like a hand pump with a cemented apron was the most common space for both cleaning dishes and washing clothes. Men were usually not involved in this activity. Mostly participants were seen to be either in squatting or L-shaped for performing these activities. What was of prime concern was reachability to the water source and comfort in the posture of performing the desired activity. In case non ambulant women had to perform the job of cleaning utensils, human assistance was required for carrying the utensils to the cleaning place.

Sonia (respondent no. 24) said, she had to depend on her mother or siblings to keep a bucket of water for her to clean the utensils, as she had to crawl to reach the washing position as there was no water source in her house.

Sushma (respondent no. 7) reported that she used a stool whenever she felt inconvenient to wash utensils in front of the tap in her home.

Meera Devi, (respondent no. 10) who worked independently shared her need of having a water source in her home as one of the greatest helps that one could get. Being single and living with her 65 year old father, she was felt herself dependent on the neighborhood to fetch water which was required for cleaning and washing purposes in addition to other household chores.

5.7 SOCIAL PARTICIPATION

Social participation accounts for one of the important set of activities of one's daily routine. It plays an important role in determining their integration with the other able bodied members of the community and their own quality of life. Lack of social participation for persons with limited mobility can lead to exclusion. To what extent the

people with mobility impairments are involved in several levels of societal participation, was also discussed with the participants under five sub themes viz. Leisure activities, Friendship Networks, Family support, Health based participation and Religious Participation. All these activities gave enough clues about an overall social health status of the persons with mobility impairments in the study.

5.7.1 Leisure Activities

Almost half the respondents did not have a high perception about their degree of participation in leisure activities. In contrast to many other respondents, it was observed that some of the respondents had developed skills that exhibit a productive nature in their leisure activities. For example Azad used to make models out of mud (Fig.5.100), while Sandeep in addition to his tailoring activity, used to make sceneries out of straw (Fig.5.102). Shahzadi's father had bought her candies (Fig.5.101), etc. to sell on a cot outside her home which would keep her engaged in some leisurely way. Few of the respondents shared that they did not have much time left after the day's work for any other leisure activity. However, among elders, neighborhood gossiping formed the main leisure activity.

Fig. 5.100 Azad with his 3d clay model of his house as a leisure time creation.

Fig. 5.101 Shahzadi selling candies on her cot as a leisure activity.

Fig. 5.102 A scenery created out of straw by Sandeep as a leisure activity.

5.7.2 Friendship Networks

Friendship networks were a clue to understand the degree of support available from the friends circle which would extend beyond the family. It was considered an imperative component of social participation activity wherein the disabled members of family could ease out through sharing discussions with peer groups.

Meera Devi (respondent no.10) responded by saying, "The thinking of people must change. I find it as the biggest trouble due to their backward thinking especially when I have to move out alone, though very rarely."

Raj Kumar(respondent no.2) said that he doesn't have much time for social mixing up while he is at home in the village since he has to study for his computer classes. He also added that, "Sometimes, I go out with friends in the evening, but not always. In the school, my friends lift me up from my tricycle and place me in the classroom seat."

Neeraj Kumar (respondent no. 12) said, "I go out on rickshaw to buy vegetables, grocery etc. I spend time to interact with friends on the nearby barber's shop. It's tough to climb up. I do attend marriages with friends. I don't care what people say about me."

Rajender (respondent no.27) All village people support and carry a positive attitude. I depend on young children around, for certain things as I am unable to walk long distances. I can't go to get my sewing machine repaired.

Sagar's (respondent no. 28) mother informed that Socially, everybody loves him and he plays with other friends of his age group. In the family he is a very dear child, the most loved one.

5.7.3 Family Support System

All through the survey it was observed that all respondents received a very strong support from their family members. Even the family members took extra care and concern for the disabled member amongst them. This was owing to a strong socio cultural setup in the study area which holds its roots from the tradition. The senior family members did express their concern about the future of their disabled member of the family. They made efforts to educate their disabled child in some way or the other. Some of the respondent's views are presented below to further gain insight :

Vikas (respondent no.1) expressed that the social support in the form of family bonding, support from mother, peer group friends is of immense value and a great feature of this community. He informed that," I receive my major care from mother, though other family members also help me in different ways."

Sushma (respondent no. 7) said, " I consider my family support as the best form of it. My brother drops me to school every day."

Randheer (respondent no. 13) also shared that he had been receiving a very good family support which facilitated his social participation to a great extent.

Saddam (respondent no.42) depended upon his family members for all physical works involving carrying weight.

5.7.4 Health Status

Most of the survey participants had undergone several medical treatments at varying levels ranging from a local medical support to the nearby town. Some of them had gone to the higher level in metro cities for medical treatment, while others later tried traditional medical system. Since, most of the mobility impaired persons acquired disability due to polio, it was important to spread awareness about polio vaccination at village level. However, for their daily problems of pain etc. they depended upon the village level medical practitioner. Another important consideration for a medical support was its high cost.

Farhat's (respondent no. 39) family members informed, "We took her to several hospitals ranging from the local city hospital to the district hospital (30 kms away) to a multi specialty hospital in Chandigarh i.e PGI. People of the village are very supportive. But her husband has been very unsupportive to her present state."

5.7.5 Religious Participation

Religious participation through involvement in functions were other areas of inclusion of a person with disability at societal level. The survey subjects belonged to two prominent religions i.e. Hinduism and Islam wherein participation during festivals was considered an auspicious feature. Every village had either a small temple and mosque for offering daily prayers. Both such worship centres were built with a close access from the street. Following responses gathered during the survey present an image of religious participation of the mobility impaired persons in the study area :

Pankaj (respondent no. 4) shared that he goes to temple on every Monday.

Pinki's (respondent no. 8) mother responded, "We do feel and wish if we could take her to social functions like marriages etc. but we are helpless too as we can't take her."

Rekha Rani (respondent no. 9) told, "I do attend marriages, religious ceremonies in the temple. I don't have much problem in participation in these activities."

Sattu's (respondent no. 18) elder brother informed, "He doesn't participate in any marriages or religious functions, though he by himself is very spiritual and religious minded. He always keeps praying."

Deepak's (respondent no. 26) family members informed that,"He attends no marriages or social functions as he can't move. He stays at home only."

Vinay (respondent no. 29) told that he was afraid of stampede / rush, that's why he did not prefer going to temples etc. during festival times.

Pappu (respondent no. 30) said, 'I don't attend social or religious functions as I'm scared. People tell me that I'll have problem attending the functions/ ceremonies.To attend fares, others will have to take care of me, more than their ownselves.'

Pinki's (respondent no. 31) parents told that she does not attend any marriages, social functions, fares or anything of that sort, as she herself doesn't feel like from inside. Otherwise, social mixing up is good.

Sandeep Kumar's (respondent no. 32) family members said that we take him to marriage functions by lifting him in our arms as he cannot use any assistive device. Though, mobility is the biggest concern for him.

Raj Kumar (respondent no. 2) said, "For offering prayers, I go alone. I go to a particular temple in the city where I can keep my tricycle and I find it easy to reach inside it. "

5.8 PERCEPTIONS OF DISABLED RESPONDENTS : A MIXED RESPONSE

The discussion, while proceeded in a natural flow, certain issues were raised by the participants on their own which led to narration of their own personal experiences and feelings in the form of their desires, aspirations and thinking. This qualitative data may hold a great value in gaining insight into their thought process and direction with a hold on socio cultural practices. Reliance on other people's assistance was very much a common theme in all the discussions regarding the participant's conditions, and it was accepted by most as being an inevitable part of their lives. As briefly outlined earlier the social perception of disability in India (as it is elsewhere) is a barrier in itself. Disability is seen as an individual problem rather than a social problem. In most cases all members of the family must work from as young an age as is possible because their well being depends on it. There is often little or no money for expensive medical treatment and disabled family members are often left to their own devices. Perhaps because of this, gaining employment was seen as the primary aim by many of the participants. There is enough scope for improvement in developing levels of independence for people with mobility impairments by both shifting attitudes and by making alterations to the dwellings and the community infrastructure facilities in the settlements, which could vastly increase many of the participant's participation in ADLs and which could have a supplementary effect in generating self employment through a vocational training. There were no high environmental design based aspirations on their minds since they were found to be on one side ignorant about the possible potential of environment based interventions in there lives and on the other side, they depended upon the village administrative heads for looking into the village infrastructure development .

5.9 BARRIERS AND FACILITATORS - A COMPREHENSIVE LOOK

Detailed analysis and discussions on the issues of ADLs in the chapter above pointed out certain barriers and facilitators as identified during the survey. A comprehensive list of the barriers and facilitators as observed during the survey is presented below:

S.No.	BARRIERS	FACILITATORS
1.	**MOBILITY**	
	Uneven Pathways	Leveled pathways with regular maintenance.
	Narrow turning radius for tricycles and wheeling devices.	Wider streets for ease in turning of tricycles / rickshaw.
	Presence of wide open drains	Drains with drain covers
	Lack of supports while moving	Provision of resting surfaces like sitting platforms, benches etc. could provide a comfort to the people with mobility impairments.
	Lack of resting spaces to walk long distances	Soft ground with compacted earth as a facilitator to prevent injury after fall.
	Hard surfaced materials like brick coba, etc. caused injuries to the knee for those who crawled.	Better slopes of pathways to avoid water stagnation.
	Swampy pathways with stagnating water.	Well illuminated streets to facilitate mobility.
	Slippery surfaces with no grip	
	No or very low illumination on streets for walking during night	
2.	**CLIMBING ACTIVITIES**	
	Too high or too low Thresholds	An approach with steps for easy climbing rather than one single threshold rise.
	Raised rim around the apron of open water sources	Presence of supporting grab rail to hold while climbing up/ down the thresholds/ stairs.
	Steps with high risers	
	Lack of support on either sides to climb up/down the staircase	

3.	TRANSFER ACTIVITIES	
	Transfer heights. Sharp edges of the transferring surface. Manoeuvring radius for wheeling devices to park for sideways transfer.	Use of transfer aids like a sliding wooden board. Rounded edges of furniture or portable items in the spaces likely to be used for transfer activity. Space clearance for sideways transfer
4.	**FETCHING WATER**	
	Far off distance from the water source. Uneven pathways as intermediate barriers. Drain near the hand pump space. Raised apron or high plinth around the water source. Height of the hand pump handle Unusable configuration of handle and outlet Lack of space to sit comfortably Slippery surface with water High pressure exertion on the pump handle to eject water. Lack of support to stand. Uneven grounds around the hand pump.	Location of water source in proximity. Leveled surfaces either with concrete or brick paving. Provision of drain cover. Gradual sloping access to the apron space to fetch water. Raised platform around the hand pump. Right angled configuration of hand pump and its handle. Rough surface finish to avoid slipping. Long lever handles for easy operation of hand pump. Grab rails to support standing posture. Paved surfaces around the hand pump space.

5. TOILETING

Away from the home.	Toileting space in close proximity.
Uncobbled surfaces to reach toilet.	Leveled surfaces to facilitate easy reach.
High thresholds for entrance.	Access to thresholds through ramped surface preferably with stepped landing.
Absence of water source inside the toilet.	Wider doorway (min. 2'-9")
Narrow door upto 2'-6" wide	Door opening inwards
Outward door opening.	Provision of internal support structures (grab rails)
Lack of support inside for turning and positioning to defecate.	Extra space in the front of toilet for transfer from wheeling devices.
Lack of space inside for transfer from ground mobility device.	Iron chain, rope or string for operating door.
Presence of no holding mechanism on the door.	Sideways approach to access the toilet.
Holding handles at improper heights which are inoperable from squatting positions.	Finished floors for easy cleaning and maintenance.
Frontal approach for toileting.	Niche for keeping lantern/candle at night.
Cleaning of toilet surface.	Battened doors / Curtain made out of cloth, jute sacks or plastic sheets to function as low cost alternatives to doors.
Lack of lighting for toileting during night times.	Thatch enclosure with a concrete slab and hole in the ground as a toileting option.
Lack of doors for privacy of the activity.	Provision of community toilets.
Soft grounds in the open fields.	

6.	**BATHING**	
	Non proximity of the bathing space	In close proximity to the house.
	Uneasy approach	Levelled approach.
	Thresholds (too high or too low)	Low thresholds with platform extending outside the door.
	Narrow doorway (upto 2'-6")	Wider doorway of upto 2'-9" min.
	Improper heights of bolting or latching.	Provision of iron chain or rope to bolt and operate the door.
	Lack of support to hold while crossing threshold.	Door handle on its front side acts as support while opening and climbing threshold.
	Lack of support to bend and get up while performing the activity	Internal support provisions in the form of handrails.
	Lack of support elements to hang clothes after undressing	Low height hooks for hanging clothes.
	Improper heights to access soap and other accessories	Niche or stone slab in corner at low height for keeping bathing related accessories.
	Lack of privacy especially for female respondents.	Curtain as an alternative to door when not affordable.
	Risk of slipping on wet floors.	
7.	**EDUCATIONAL ACTIVITY**	
	Non availability of a school in the local premises.	Provision of primary school in the village.
	Distance of the school from village.	Easy reach by centralizing location and leveled pathways.
	Classrooms on upper floors.	Ramped access to classrooms above ground floor.
	Lack of access to drinking water and toilet facility in the school.	Access provisions as for fetching water.

8.	**HOUSEHOLD WORKS**	
	Manoeuvring for utensils and other accessories needed for cooking. Reach to the chulha Water source not available near the place of cooking. Cleaning utensils is tiring in squatting posture.	Ground level mobility device Low height wooden stool for ease in cooking. Water stored near the place of cooking can facilitate the activity
9.	**EMPLOYMENT ACTIVITY**	
	Lack of vocational skill training Human dependence for basic ADLs, lowers one's morale. Lack of disability certificate for benefit from Govt. schemes.	Availability of a vocational training centre or support in the village NGOs involvement for counseling Disability assessment on a regular basis can facilitate disability certificates to the rural persons with mobility impairments and aid in identification of disabled persons for census.
10.	**SOCIAL PARTICIPATION ACTIVITIES**	
	Inaccessible spaces for social gathering Steps in front of religious places. Crawling makes the clothes dirty restricting participation in ceremonies, festivals. Lack of resting spaces.	Accessible Village Panchayat Ghar as a facilitator for inclusion in village level decision making. Access through sloping pathways in addition to steps in front of religious places. Brick platforms along the pathways serve as resting spaces.

5.10 DESIGN CRITERIA AND RECOMMENDATIONS

Discussions were held with Block Development Officer, Village Pradhans, Rural Engineering Service engineers of the district to gather information about the design guidelines for the existing infrastructural facilities in the study area. Following findings were revealed through the discussion :

1. No information was available about access provisions or such guidelines in their designs.
2. Design improvisations were restricted to basic improvements in the engineering aspects of handpump. Since the major attention was on executions, designs were never looked upon to be improved.
3. Disabled people's perspective was never given any thought from an environmental design perspective. Though, there was a consensus that they had not seen many disabled people on the village streets, there was no further exercise done to identify their needs and thus make design improvisations.
4. There was lack of initiative to advance their designs.
5. Including ramps at design stage would cost much less than to make alterations in the existing structures.
6. Several design alternatives were then discussed with the people with disabilities who said that they were never involved in any schemes and no benefit had reached them so far.
7. They were otherwise aware at the cursory level about the Government schemes to help people with disabilities.

Thus, based on the understanding of literature, physical surveys, discussions with the mobility impaired survey participants along with their family members and opinion of experts, the following design criteria framework for designs to enable people with mobility impairments was evolved :

1. **Improve mobility and support**
2. **Improve Access**
3. **High Adaptability to use the environment for a desired function**
4. **Cost Effective Solutions**
5. **Socio Cultural Relevance**
6. **Use of Locally Available Materials**
7. **Inclusive in its approach**

Discussions for removing disabling barriers and creating enabling environments were held twice. On both the occasions, the starting point for discussion was their ideas on how their existing facilities could be improved to meet their needs better. The process followed with the people with mobility impairments was as follows :

1. Two focus groups were formed in two villages, one with seven and another with ten participants with a mix of survey respondents (mobility impaired) and their care givers.
2. The sketch designs based on the understanding of problems during survey were drafted by the researcher.
3. An open ended discussion was held to receive further ideas tp incorporate as design recommendations.

It was felt unethical to spend time discussing solutions with disabled people and then not to provide support for a solution. For this reason, the researcher intends to draft a project proposal to be sent to the Ministry of Social Justice and Empowerment to seek funding for the ideas generated. It is expected that the adaptations/solutions generated will be put into practice at a pilot mode, with support from relevant organizations and the community members of the village. Further modifications and refinements in the design shall then be done to adapt to diverse needs of other disability groups and for cross cultural acceptance. Thus, a set of design recommendations derived from a series of open ended discussions, observations and understanding followed by conceptual design solutions are presented below:

1. Pathways

The quality of pathways varied with respect to their hierarchy. Main access roads to village were metalled or concreted. Further subsidiary lanes were either brick paved or had compacted earth surface. However, the compacted earth roads were often uneven and eroded, causing problems for some of the ambulant disabled participants and the non ambulant subjects with wheeling devices. Thus, improving the pathways was an evident priority for many of the disabled inhabitants. This could be done by a range of surfacing options like a compacted earth road, stabilization of an earth road, gravel surfacing on a sub-base of compacted earth or building debris, brick or block paving, concrete pavements, a water bound macadam surface or a bituminous macadam (penetration or surface dressing).

Construction methods should also be taken into account as they depend on soil conditions, climate, cost, social preferences and the suitability of labour intensive techniques as opposed to the use of machines.

2. Open Drains

Open drains running along or crossing the pathways formed a common barrier that drew a dividing line for the mobility impaired person's reach. Most of the drains observed in the study area had no lining and were being extensively used to carry sullage (from both houses and water sources like hand pumps) and storm water. These need to be upgraded with any road or pavement surface improvements. Also stagnating water in the drains required improvement by increasing the gradient of the drain. It was observed that the drains were not only a limiting factor for ambulant and non ambulant disabled, but also for the weak, elderly and children they posed as trip hazards. Thus, a series of alternative design solutions as suggested in Figs.5.103 (a),(b), (c) and (d) are presented which shall aid in crossing over of drains with much ease. The figures suggest the use of a tight fitting removable covering slabs (of stone or precast concrete) with flush fittings to the road surface. In cases where flushing is not possible a gradual sloped access shall facilitate ease in crossing over the drain. Also, the author derived an alternative idea from the survey observations that where a sewer pipe could be sloped over along its curvature to cross the drain. While, the ideas presented here were discussed for feedbacks, almost all members of the focus group rated a high opinion of acceptance. An alternative idea was also proposed by a respondent in the group that iron grating grills could also be used to cover the drains. There was an issue raised by a caregiver of a disabled respondent about the maintenance and their breakage, which as discussed in the group led to the community participation approach for its upkeep and the neighborhood people also to accept it as their responsibility rather than assuming it to be an individual problem.

3. Entrance Thresholds

Thresholds at the entrance of the residences or environments for public use like schools, village panchayat etc. were observed as a common barrier. Thresholds over 6 inches were considered a barrier, difficult to cross by few ambulant disabled and all non ambulant respondents. Alternatively steps at the entrance could be added to facilitate crossing a

high threshold by breaking it into two or three small risers. In buildings with a larger public domain like village primary school or panchayat ghar, a ramp with a gradual slope (min. 1:20 and max. 1:12 as per International Standards) could be provided alongwith the steps at entrance. Grab rails for better grip as an additional support would further aid balance to the ambulant disabled and elderly people. Ramps with intermediate stepped landings would be considered a better alternative as it provides resting spaces to the weak.

4. Fetching Water Facility

Water was observed to be a prime element in activities of self care. Availability and accessibility to water, irrespective of one's physical attributes thus becomes an important concern to be appropriately addressed which has been highlighted under the following terms :

a. Proximity – Reducing distance to fetch water for persons with mobility impairments becomes the foremost need. If not available at home, water source (either hand pump or piped water supply) should be available within a range of 50 feet. This shall not only enhance independence to fetch water, but also reduce the overall time and effort in fetching and transporting water. It would largely benefit diverse user groups in a rural environment.

b. Reachability – Provision of a leveled path or a path with gentle gradient as a medium to reach the water source would facilitate reach immensely. Concrete paths, though expensive are more durable and can serve a long term need as against mud paths which turn into swampy areas especially during rains or due to drain overflow. Also the location of hand pump could be chosen accordingly wherein such a path could be built.

c. Accessibility – As observed during the survey, hand pumps as a common water source were installed in two types of spaces viz. rectangular plinth (of common size like 4'-6" x 6'-0") or a cemented circular apron (of 6'-0"dia) around it. High plinths (6" to 1'-0") and

the rim edges (6") in case of circular aprons denied access to the locomotor disabled. Alternatively three conceptual solutions are proposed (Fig.5.104 a,b,c). Fig. 5.104(a) suggests a single straight ramp connecting to the plinth height (in case plinth height varies between 6" to 9"). Fig.5.104 (b) suggests a L-shaped ramp with two intermediate step landings at corners leading to the plinth level of the hand pump (in case plinth height is 1'-0" and above as may happen due to site constraints). Fig.5.104(c) suggests an alternative adaptation into the existing circular apron. Access through a drain cover over the adjacent drain followed by a sloped approach to the apron shall allow an easy access to even the non ambulant disabled. These suggestions were in the light of the infrastructure seen as available in the study area which could be made accessible. It is further recommended that the slopes of ramps be made rough either by cutting grooves or by use of non slip material to avoid slipping of users. Realizing that many disabled people in the rural environments crawl to move, grab rails along the circular rims are also considered in the suggested design which may facilitate their movement posture.

d. Usability – To facilitate use of the space and the water source (hand pump), as was observed during survey, that a 90° configuration between the handle and the outlet served better than other options (Fig.5.104,c). This option was considered more suitable for cases when the hand pump is installed much inside the apron space as it allowed the user to use the pump and at the same time hold the container to collect water. However it was found that a 180° configuration would suit the case when the hand pump is installed on the corner of the space. Also, increasing the length of the handle reduces effort to draw water. A low height outlet would serve better use to the non ambulant disabled, though it also needs to be ensured that a bucket or a large jerry could be easily placed under the outlet at low height. Alternatively a low height platform could be created on the rim of the apron to sit and use the hand pump.

e. Safety – Safety from slipping and use at night can be ensured by use of rough finish for the apron and the ramp surface. Installation of street light near the water source could be

strategized while planning the locations. This shall enhance better visibility of the path around at night times and thus facilitate access.

5. Toileting Facility

Toileting as a sanitation activity was observed to be the most cumbersome activity for several participants with limited mobility. It was also observed that quite a few respondents had to go to open farms for defecation which was even more troubling, for female participants with limited mobility. The recommendations for the provision of accessible sanitation facilities are presented as follows:

a. Proximity – One of the essential criteria as observed in use by the persons with restricted mobility was the distance to the toileting space. The larger the distance, greater the difficulty. Though, many respondents as observed had one or the other type of toileting space available, there were some who could not afford even that. It is thus recommended to propose the construction of community toilets in the rural areas to facilitate access to a healthy sanitation space.

b. Reachability – Reach to a toileting space could be facilitated by removing intermediate barriers of uneven pathways and thresholds. Thus, as suggested in the previous themes, leveled pathways made of either concrete or brick paved would improve reachability to the toilets. For toilets with high threshold, the pathway should be gently sloping to even facilitate the reach of non ambulant persons either crawling or by using wheeling devices. A flat area outside the toilet door is highly recommended, so as to ensure stability of ambulant disabled and wheeling device users and also for easy access inside. The size of the platform should be wide enough to allow a wheeling device to be comfortably parked with optimum clearance.

c. Accessibility – Accessibility to the toileting space inside was primarily controlled by the thresholds and the doorway. Thresholds beyond the crossing limits of people with lower limb extremities, could be made approachable by constructing a ramp towards it along with steps as an option for the ones who may like to approach through that way. Also, it

is suggested to provide handrails as supports for access outside the toilet which may help people having mobility impairments with weak limb balance. Handrails could be built either with cast iron pipes or bamboos of diameter ranging between 1.5" to 2".

Doors

Door widths were found to be quite narrow in the study area, even when there were no space limitations. Based on the survey observations, it was found that several crutch and walking stick users could not enter in the toileting spaces with their mobility aids. Also, while crawling to enter, it required little more space than a standing posture, hence a wider entry of 3'-0" is thus recommended for all toilets to facilitate access to diverse user groups.

For convenience, it would be preferred to have door opening inwards since a door opening outwards would be difficult to close from inside. Also, there are hinges available which facilitate the door opening both ways. This may be used in the cases of community toilets. In cases where either of the options are difficult to manage, a curtain made out of cloth or plastic sheet or sack can provide privacy at a low cost (Fig. 5.109).

d. Usability

Internal Dimensions and Layout

It was observed that a person with mobility impairments required more space to manoeuvre inside or adapt as compared to an average able bodied person. Extra space in the front is thus recommended for a mobility impaired person to adapt to the inner layout and adjust himself to finally position himself for the toileting activity. Both front and sideways approach to toilet were observed in the study area. However, sideways approach provided easier access by reducing the number of turns inside to the complete process (Fig.5.105,e) when compared to the frontal approach.

Toilet Seat

Indian style toilet (also referred to as Asian style) were a socially acceptable toileting style with squatting posture. In cases where people used farms to defecate or used two brick platforms built as toilet seat, squatting style remained a common way of toileting in the study area. Another alternate would be to have a brick or concrete platform built with an Indian WC placed centrally in such a way that it facilitates direct sitting on the toilet seat. To enhance better usability of the toilet seat, the hole of the wc should be made wider so that its sides don't get soiled much.

Water Source

Water was not available either for personal hygiene or for flushing as a direct source in most toilets observed during the survey. Mostly respondents either took water on their own or had to depend on a family member for the same. Piped water supply could be the best possible recommendation to be implemented. Since, it could not be available at all household levels, another alternative is to build a small corner space with its inside floor raised to hold water (Fig.5.105,c). This could be filled in advance of toilet use. A tap could be further connected to it at a height of 1'-3" for an easy supply while performing the cleaning activity.

Internal support structures

As an aid to support postural changes, balance and to avoid slipping, handrails as support structures are recommended towards the inside wall surfaces of the toilet (Fig.5.105 c,d, & Fig.5.106 a to e). They could be made out of an iron pipe or bamboo with diameter ranging from 1.5" to 2". The horizontal pipe helps in lowering down to squatting position while vertical pipe aids in process of getting up after completion of the toileting activity. For support to open defecation areas, bamboo supports at two levels could be installed to facilitate squatting (Fig.5.105,a). This shall provide greater dignity and facilitate

independent functioning to perform toileting activity to those who had to defecate in the presence of a care giver.

Aids and Adaptations

Several types of aids and adaptations could be alternatively devised for ease in toileting activity. Movable seats in the form of a stool with no back rests or chair with a hole could form one of the alternative aids to facilitate toileting. Another possible alternative could be a fixed frame of wood or iron, hinged to the back wall surface for use (Fig. 5.107). Folding movable seats as discussed in chapter 2 also form a designed solution for such cases. However, it would require further work to make it affordable to the low income communities.

e. Safety

Safety from slipping and falling can be best ensured by proper internal support structures which need to be properly secured to ground and wall surfaces for stability.

f. Privacy

Privacy could be facilitated by the use of proper doorways as discussed before. Alternatively, low cost options in the form of curtains could solve the purpose. A low cost toileting facility could also be created in the fields with a hole in the ground and surrounded by thatch walls and roof in a circular composition. This can then provide a useful alternative to the women with disabilities who find it difficult to defecate in farms due to low privacy. However, such an option would greatly need community participation to maintain it.

6. Bathing Facility

Bathing spaces as discussed in the chapter before were either the open spaces under the hand pump or were enclosed spaces exclusively designated for the purpose within the

home. In order to facilitate ease or improve independence to perform the activity by persons with mobility impairments, it would be considered important to adopt certain suggestions as follows :

a. Proximity – Proximity of open spaces for hand pumps (as discussed in the case of fetching water) and even within the household environment holds much importance for people with movement difficulties.

b. Reachability – As applicable for toileting and fetching water, reach to the bathing spaces can be facilitated by leveled pathways and minimizing barriers to mobility.

c. Accessibility – High thresholds need to be either supplemented by gradual slopes or low rounded thresholds at the entrance could provide better access to the bathing facility. Door width needs to be a minimum of 2'-9" while clear 3'-0" would facilitate better convenience to address diverse user profiles of locomotor disabilities. Battened door formed the most common option in the study area. It is important to note here that the door needs to be fitted with an operating handle to facilitate easy opening and closing. As a low cost alternate, a iron chain or a rope loop with a nail in the wall could facilitate closing mechanism.

d. Usability – Bathing space should be clear and free from any hindrances at its floor level. An internal support system of grab rails would serve to be highly useful for the mobility impaired person to undress and lower down his body for bathing. In case of open spaces with hand pumps, a high platform for seating and bathing would make it convenient to hold the hand pump as support. A height range of 2'-6" to 3'-0" was found to be reasonably good for holding as support in standing position, while a vertical grab rail was used while getting up from the sitting posture. An internal size of 3'-6" x 4'-3" is recommended as an optimum size for the bathing space with door preferably on the longer side to facilitate sideways access. A space to keep bathing related accessories needs to be created within the bathing space. This could be done either in the form of providing a one or two corner shelves or by creating a niche in the wall surface wherein, a

person while bathing can easily access soap etc. (Fig. 5.106,a to e) Certain assistive aids for body rinsing etc could further facilitate bathing process. Hooks to hang clothes for undressing could be either located behind the door or alternatively one could use a grab rail for the same.

e. Safety – Safety was an area of concern mainly from the perspective of slipping or falling due to imbalance or poor coordination of lower limbs. It was generally observed that both able bodied and people with locomotor difficulties, tripped over the thresholds which could be prevented by either minimizing the thresholds or by providing supports to hold and cross the thresholds. Also, thresholds could be extended to an outside platform for ease in entry.

f. Privacy – Beyond walls as an enclosing structure, door forms an important screening element for privacy which could either be in the form of a proper wooden (battened) door or else in the form of a curtain made out of jute sack, plastic sheet or a piece of cloth. For open spaces in the home, sleeping cot in vertical position could function as a screening element.

7. Rural Primary School

Primary schools need to be planned within the reach of village people. While the existing schools need to imbibe accessibility for diverse needs of mobility impaired children to promote inclusion. Minimizing barriers by leveled approaches, low or no thresholds, easy access to classrooms, drinking water and toilet facilities shall aid in creating a congenial environment with accessibility. Also, efforts must continue to promote access beyond physical to social and institutional environments.Fig.5.111 shows an accessible Rural Primary School as a conceptual design alternative.

8. Rural Health Centre

Village health centre offering primary health care to rural people with and without mobility impairments needs to be developed with accessibility as an integral component

of their environments. Medical rehabilitation services to the people with mobility impairments and other disabilities should also be extended through this centre. The health centre should also have a provision of access to drinking water and an accessible toilet. A conceptual design of a Rural Health Centre is shown in Fig.5.110. It integrates the ramped approach along with an optional step at the front to facilitate diversity of users in the rural environments.

9. Village Panchayat Ghar

A place for common gatherings usually for village level decision making, forms a prominent feature of the rural environments. Social participation can truly become inclusive, only when the people from weaker sections are also given a chance to participate in the village level decision making. This can be facilitated by incorporating access into the existing and new Panchayat Ghars to be built. Provision of adequate pathways with access over drains as suggested before will enhance general mobility of even the mobility impaired which shall make their reach to the Panchayat Ghar possible. The Village Panchayat Ghar, once made accessible can also function multipurposely for conducting rural level elections wherein persons with mobility impairments can also cast their vote and hence participate in political decision making. Fig. 5.112 shows a conceptual design of village Panchayat Ghar as conceived by the author with access through a plinth or alternatively by a gradual slope integrated into the building entrance. Grab rails along the ramp side and towards the entrance walls, shall enable ambulant disabled to easily access the inside environments. Promisingly, this approach shall enable others like elderly, women carrying weights etc. along with able bodied people to increase their participation to create an inclusive society.

10. Mobility Aids

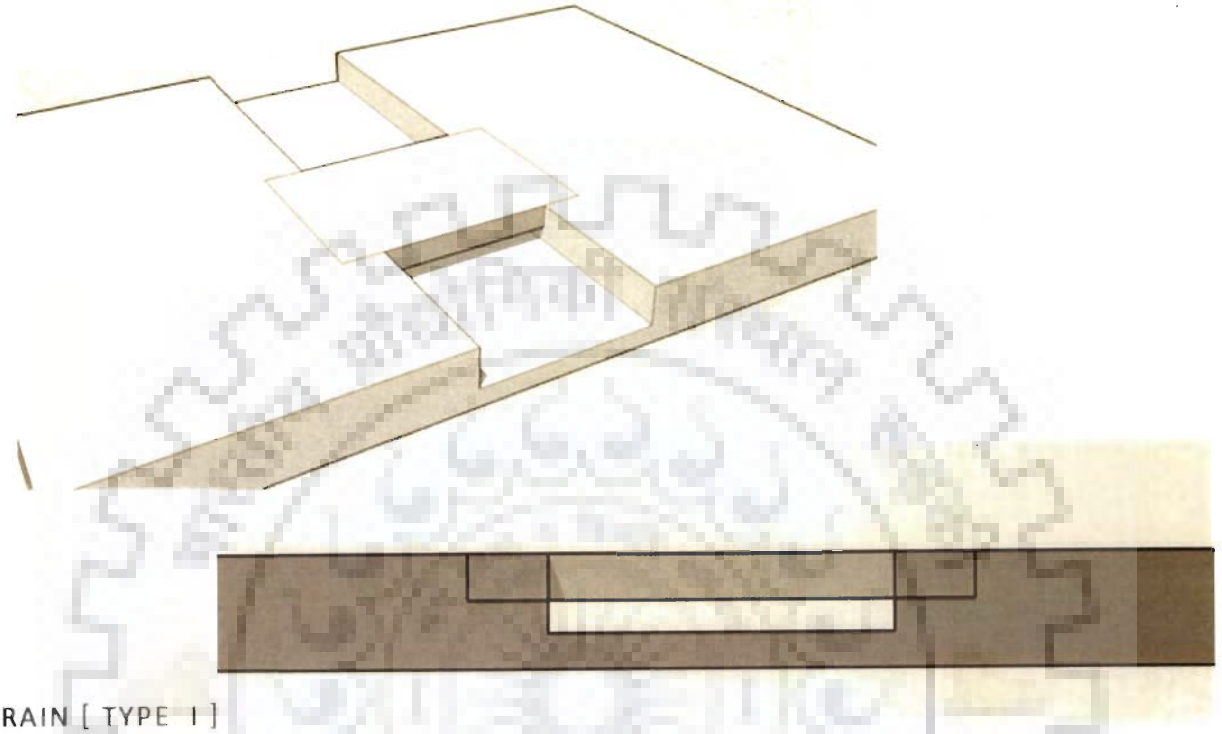
Enablement of people with movement disabilities can definitely be improved through environmental design interventions. However, the need for appropriately designed

mobility aids cannot be negated. Since most of the activities are done at ground level only, development of ground mobility devices for within the house movements can greatly enhance reachability to spaces within their homes (Fig. 5.113).

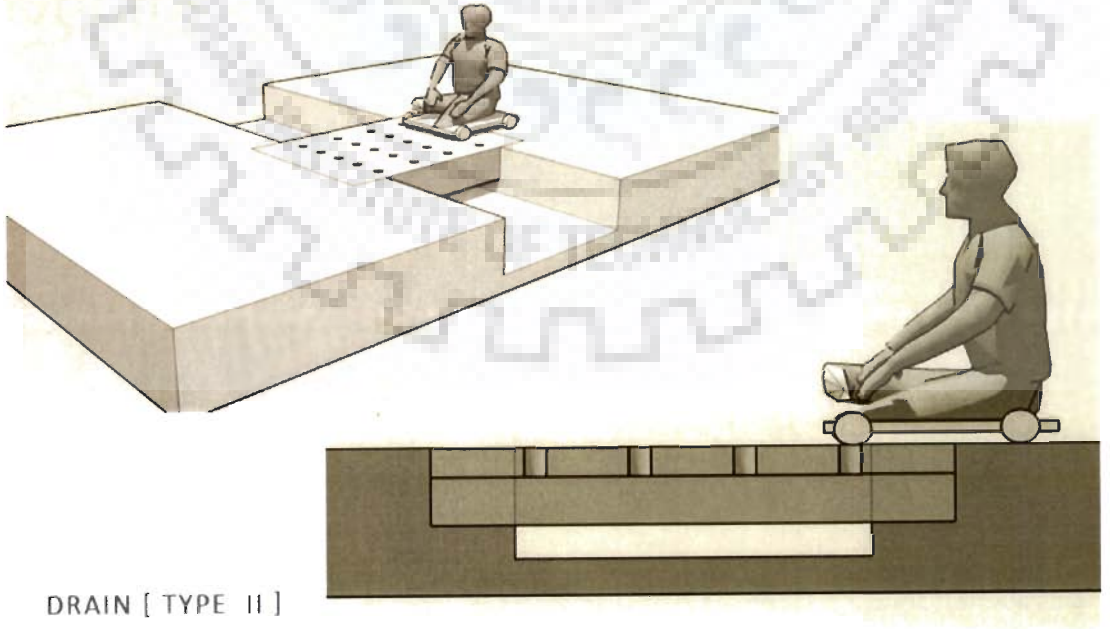
It was observed during the survey that few respondents in the non ambulant category had to crawl for their mobility needs. As a result, their knees and palms got hurt. Thick cloth or rubber pad with strings on corners to tie around the knee could serve as a low cost knee protector, against abrasion, dirt (Fig.5.113). To prevent hands from getting bruised, rubber slippers continue to be used for crawling on the floor. Wooden hand grips with rubber padding (Fig. 5.114) below could be an effective assistive device to improve mobility, as slippers would be culturally unacceptable in several contexts like going to religious places or ceremonial gatherings. Both these aids could be developed indigenously as low cost alternatives for people in the non ambulant category. In addition to the above alternative designs for crutches and other mobility devices for the ambulant disabled could be created.

The above mentioned design recommendations can find wide application and use in Indian rural environments with similar infrastructure and water sources. Villages in diverse socio cultural contexts could adapt these recommendations with improvisations in their existing designs or by conducting research to develop alternative aids and adaptations for specific locations. However, a set of conceptual design solutions were finally developed through open ended discussions with the survey subjects and their care givers coupled with an understanding formed through direct observations of ADLs as performed by the mobility impaired participants. They are presented as follows :

Fig. 5.103 (a,b) DRAIN COVER ALTERNATIVES

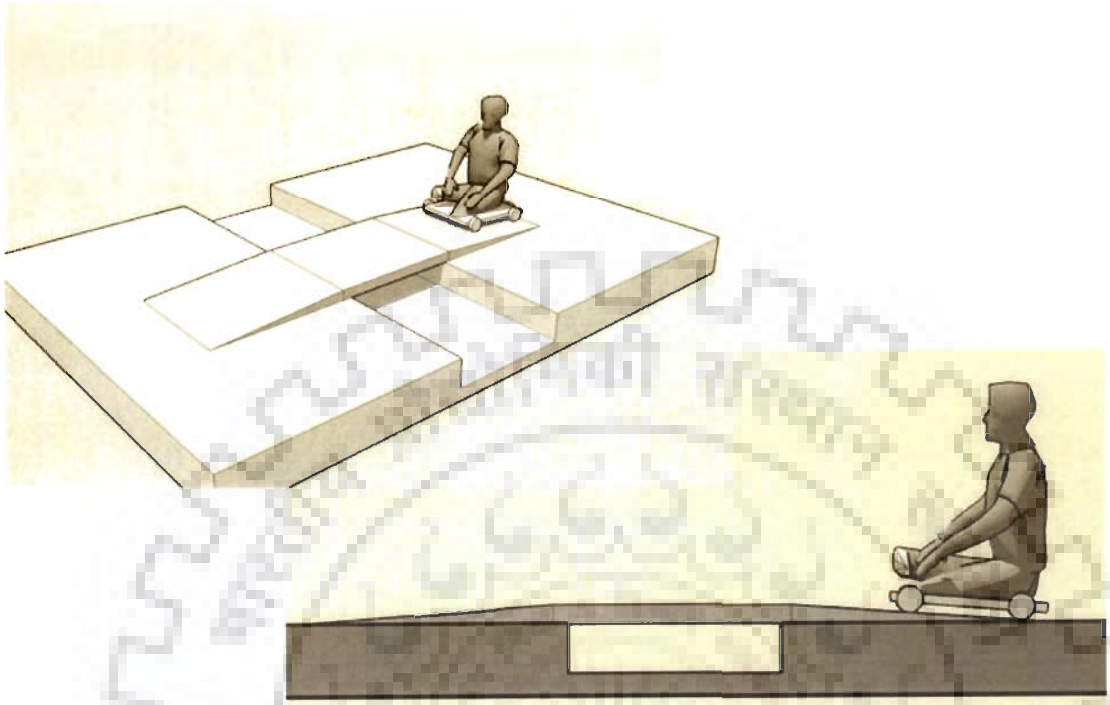


DRAIN [TYPE I]

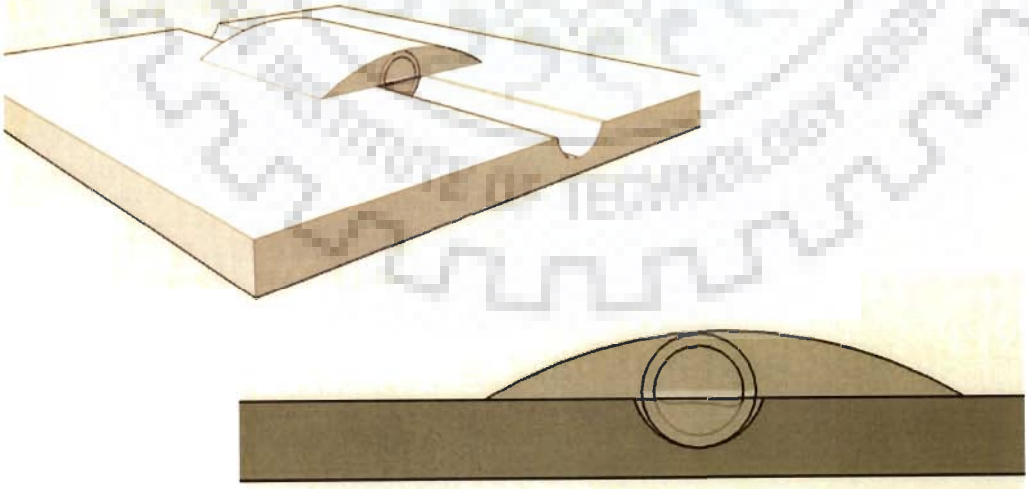


DRAIN [TYPE II]

Fig. 5.103 (c,d) DRAIN COVER ALTERNATIVES

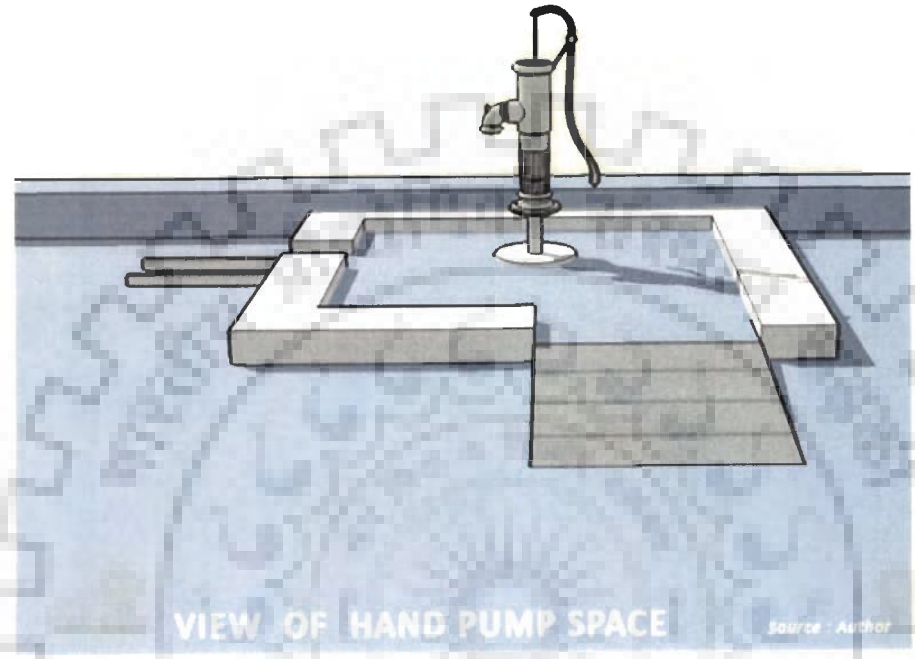


DRAIN [TYPE III]



DRAIN [TYPE IV]

Fig. 5.104 (a,b) HAND PUMP SPACE DESIGN



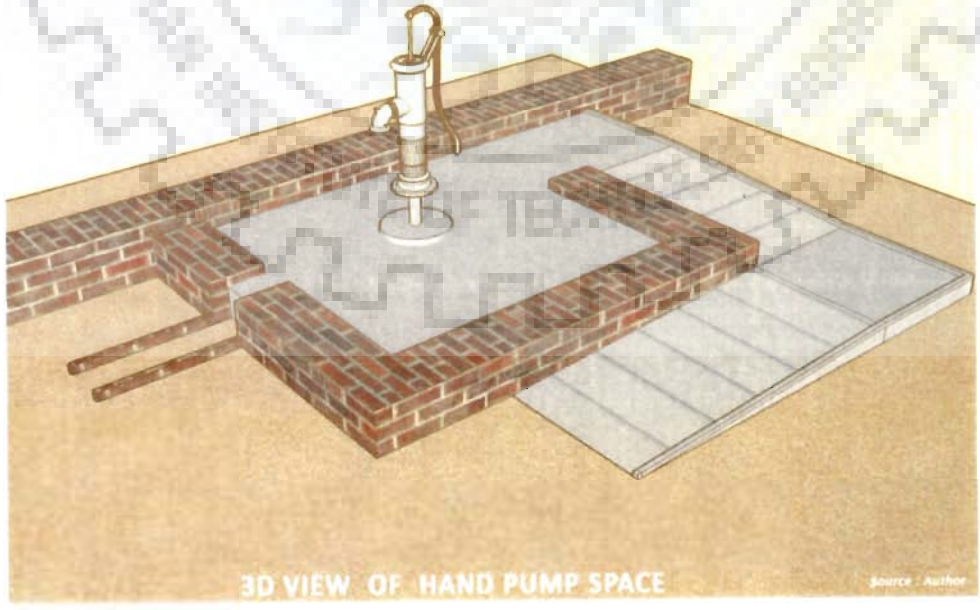
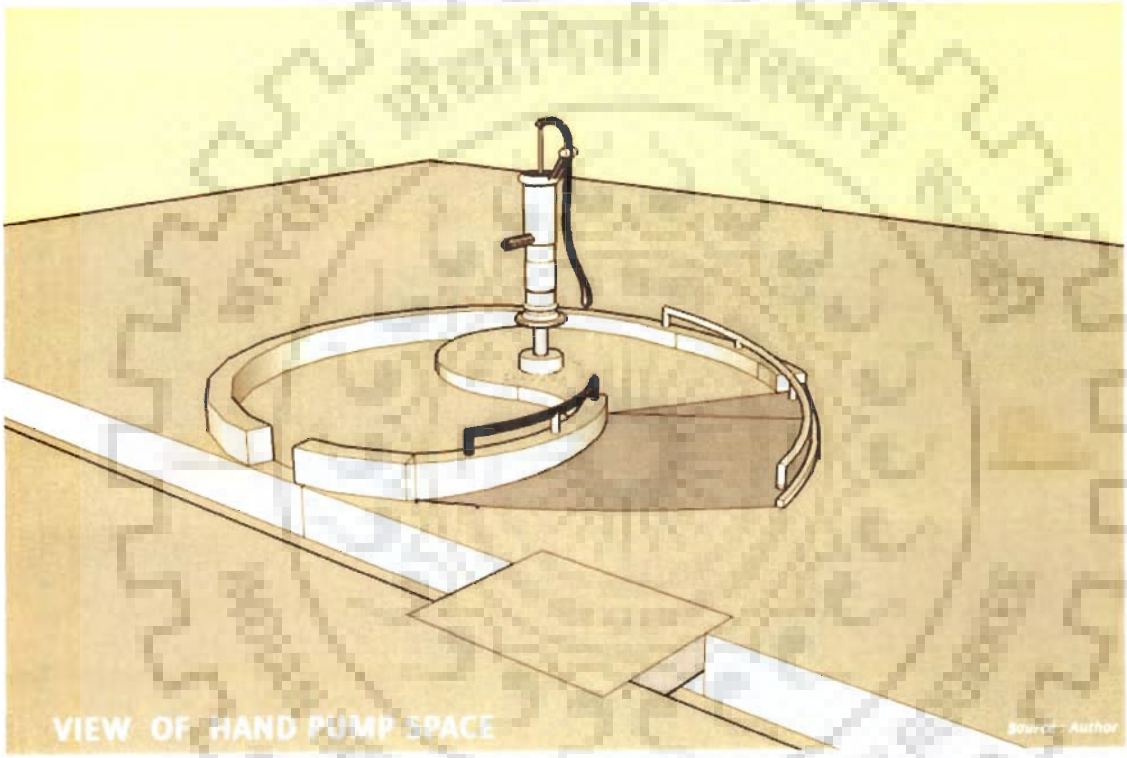


Fig. 5.104 (c) HAND PUMP SPACE DESIGN



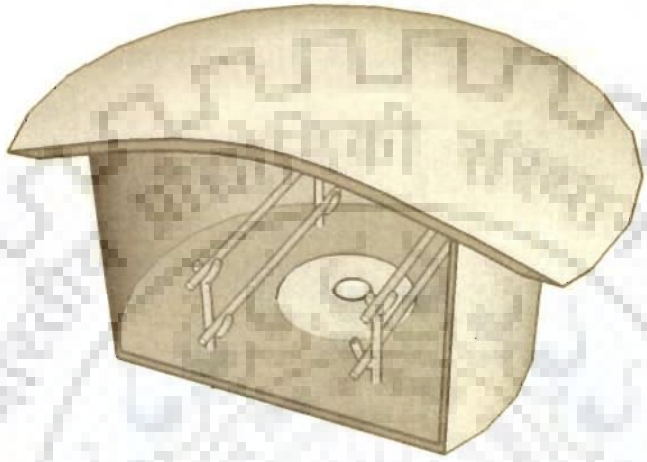


Fig. 5.105 (a) Community Toilet for Open Farms with bamboo hand rails

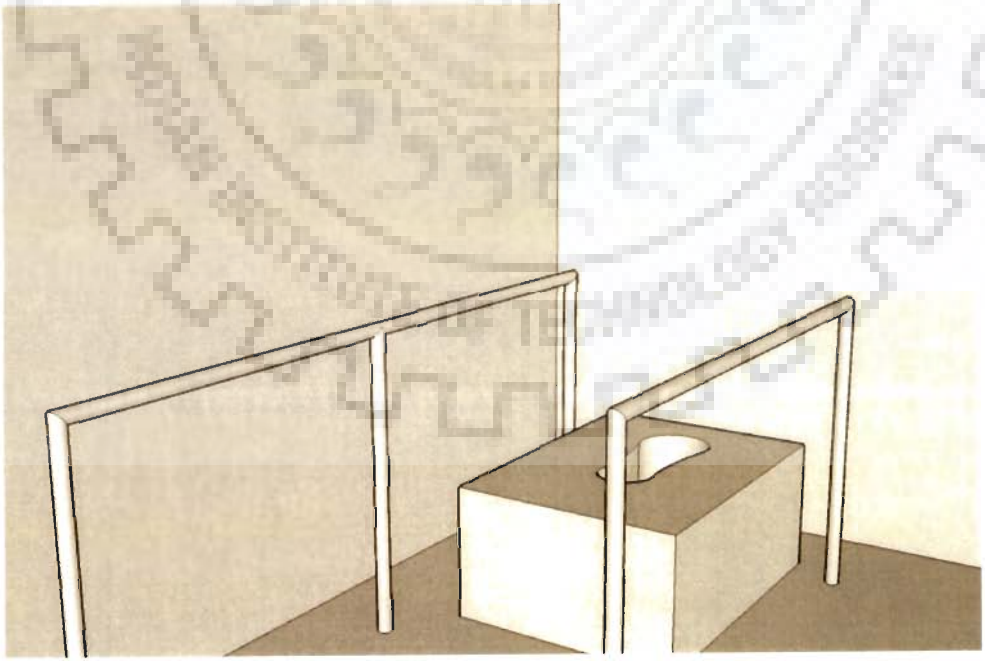


Fig. 5.105 (b) Alternative Toilet for rural areas with grab rail supports

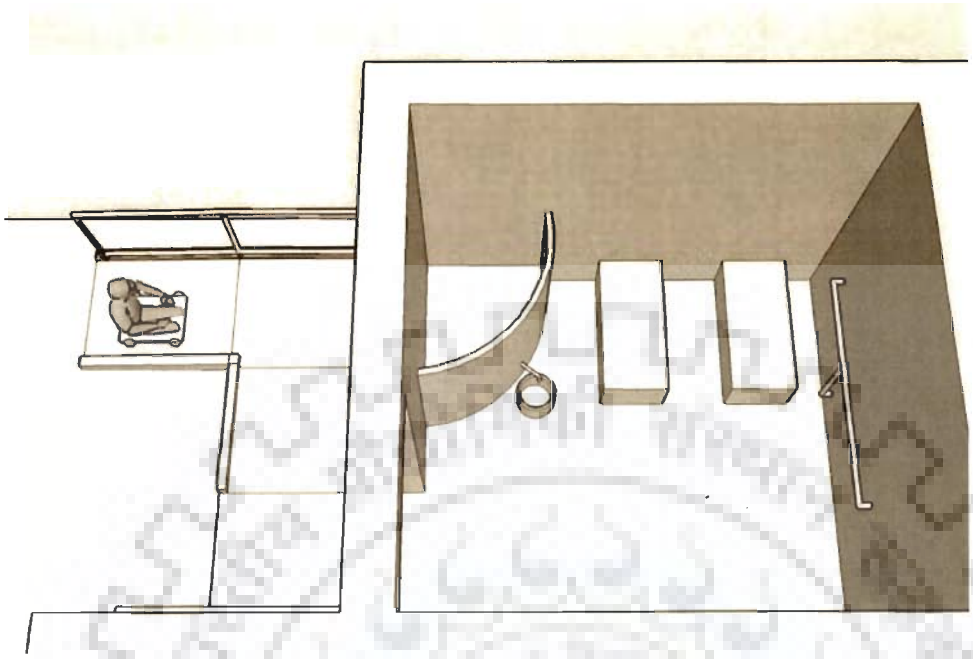


Fig. 5.105 (c) Accessible Community Toilet for rural areas with water support inside

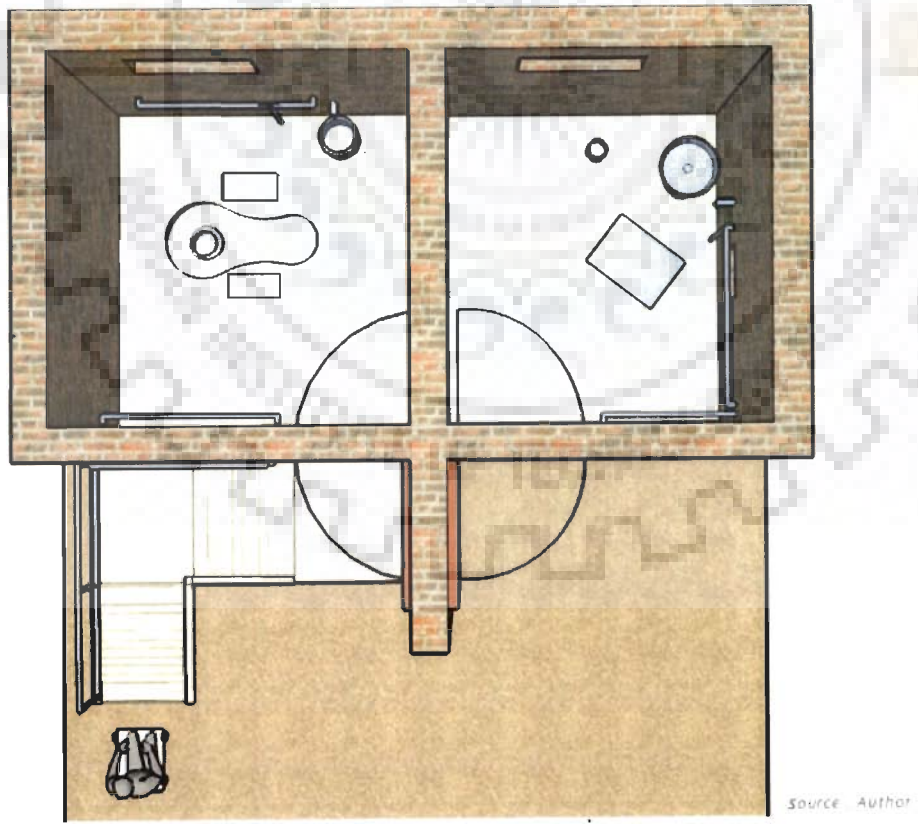


Fig. 5.105 (d) Accessible Community Toilet & Bathroom for rural environments

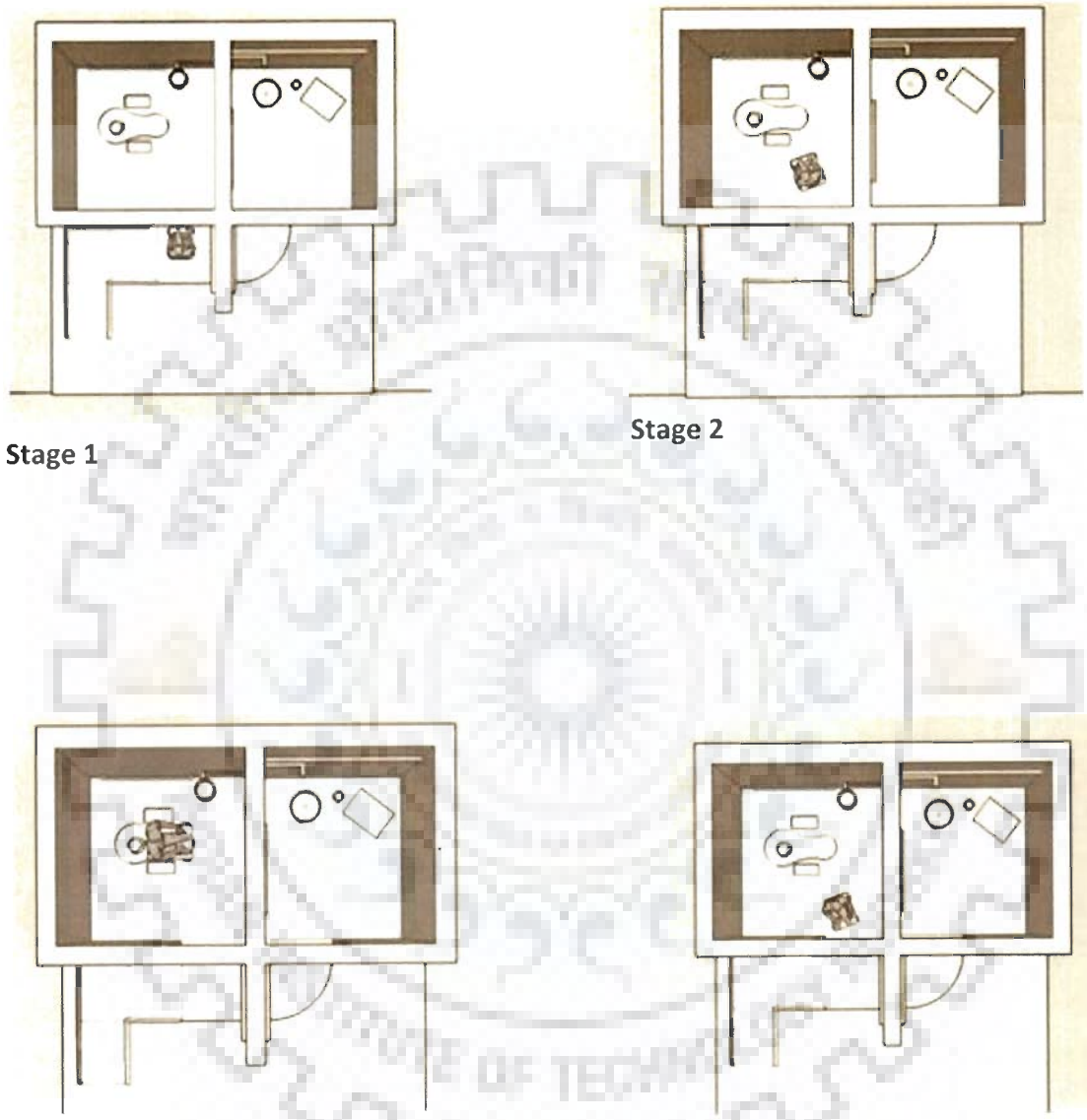


Fig. 5.105 (e) Toileting Process Illustrating sideways approach with reduced no. of turns

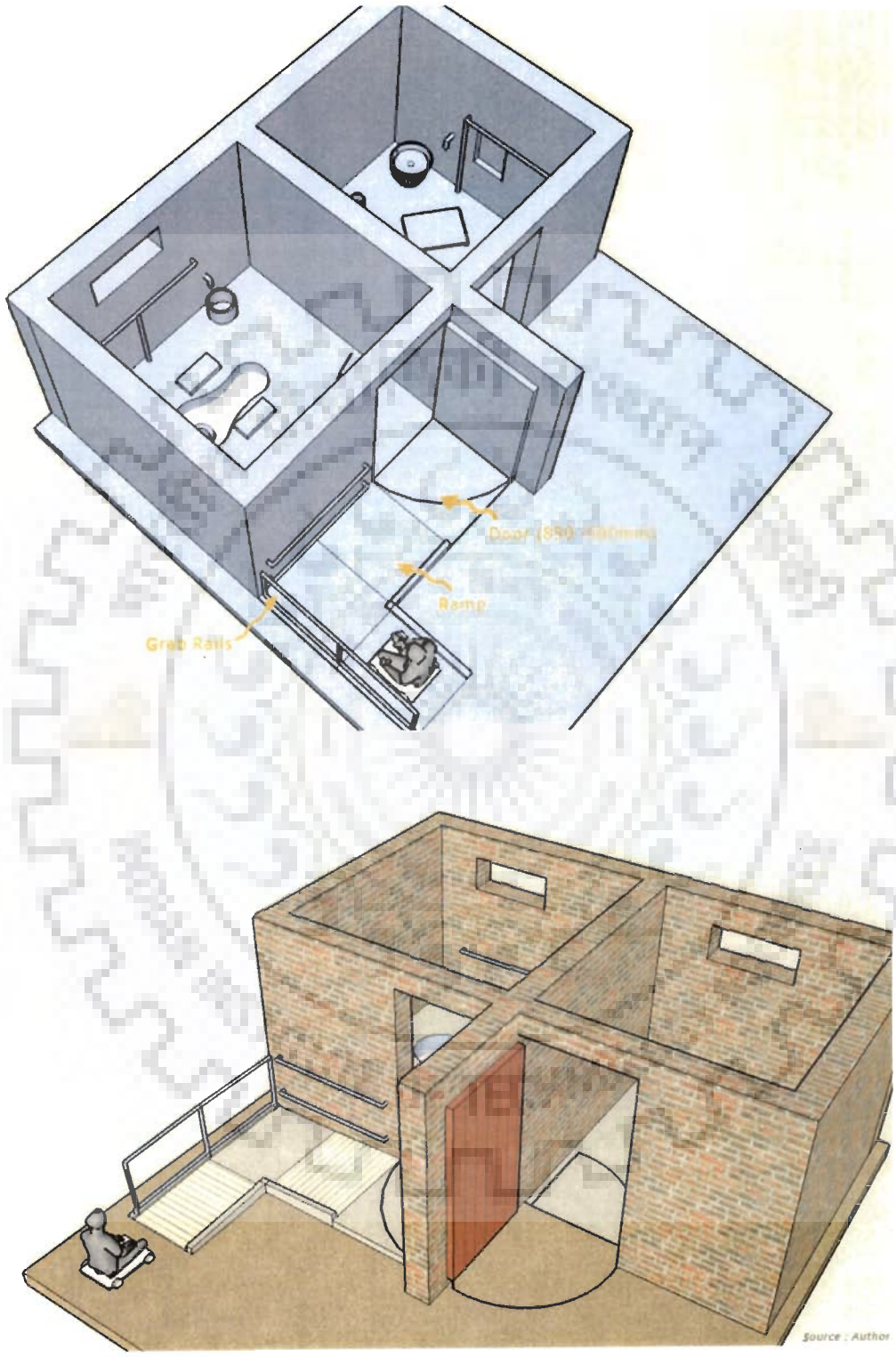


Fig. 5.106 (a,b) 3D views of Toilet & Bathing Space

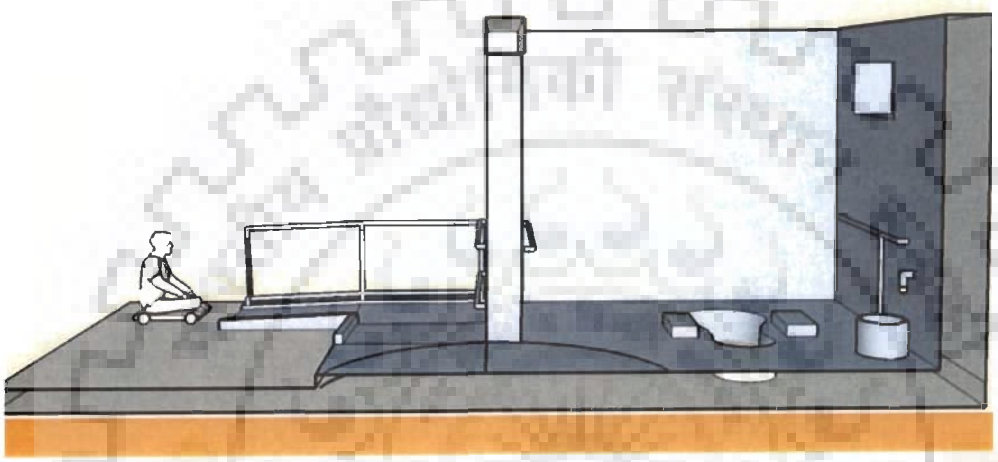


Fig. 5.106 (c) Cross Sectional View thru' Toileting space

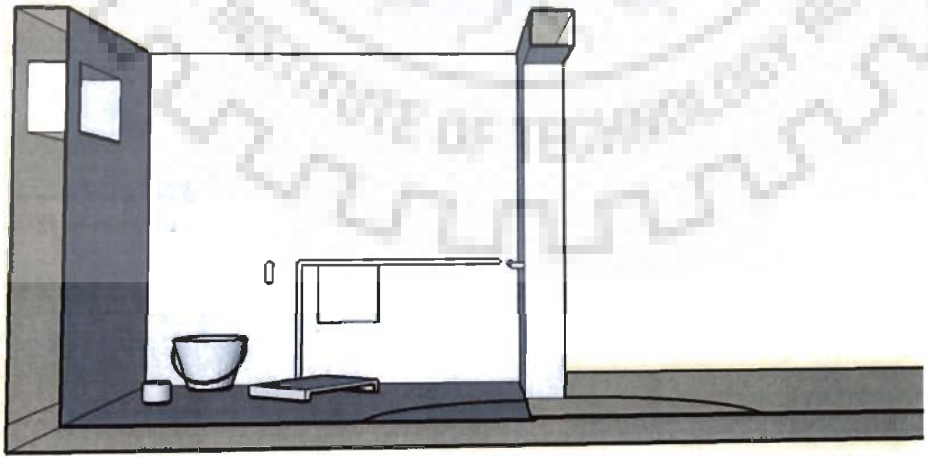


Fig. 5.106 (d) Cross Sectional View thru' Bathing space

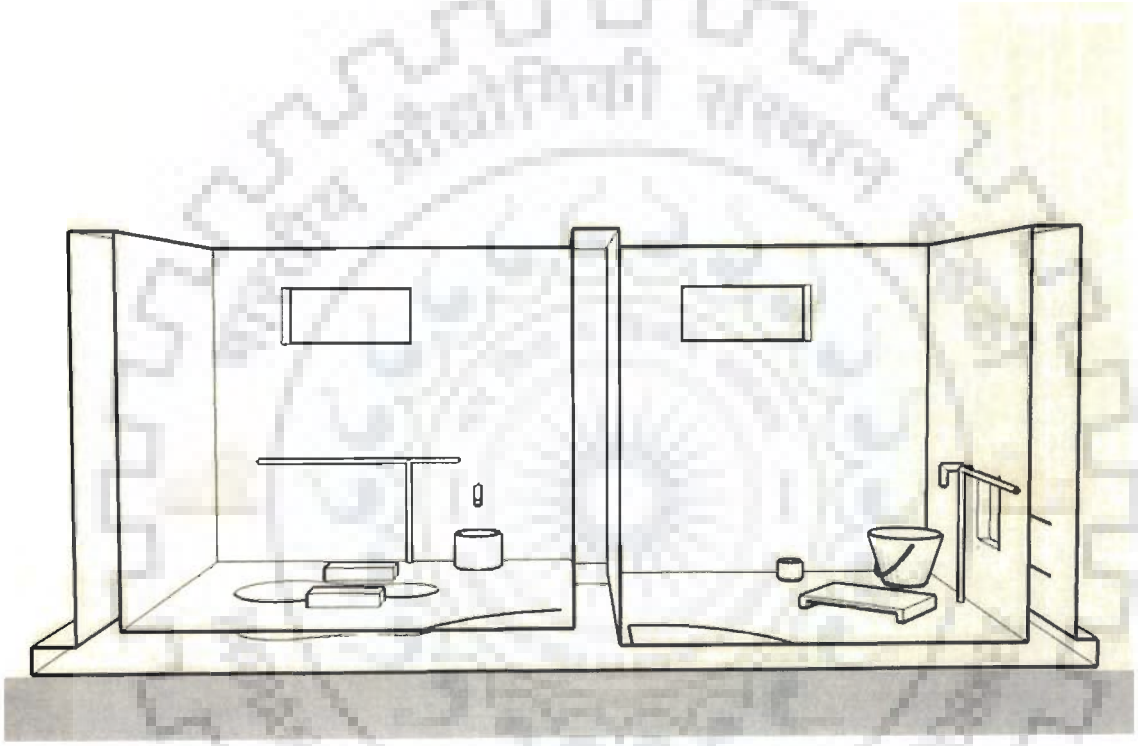


Fig. 5.106 (e) Longitudinal View through toilet and bathing space showing the position of grab bars in toilet and bathing space along with a low height niche in bathing area.

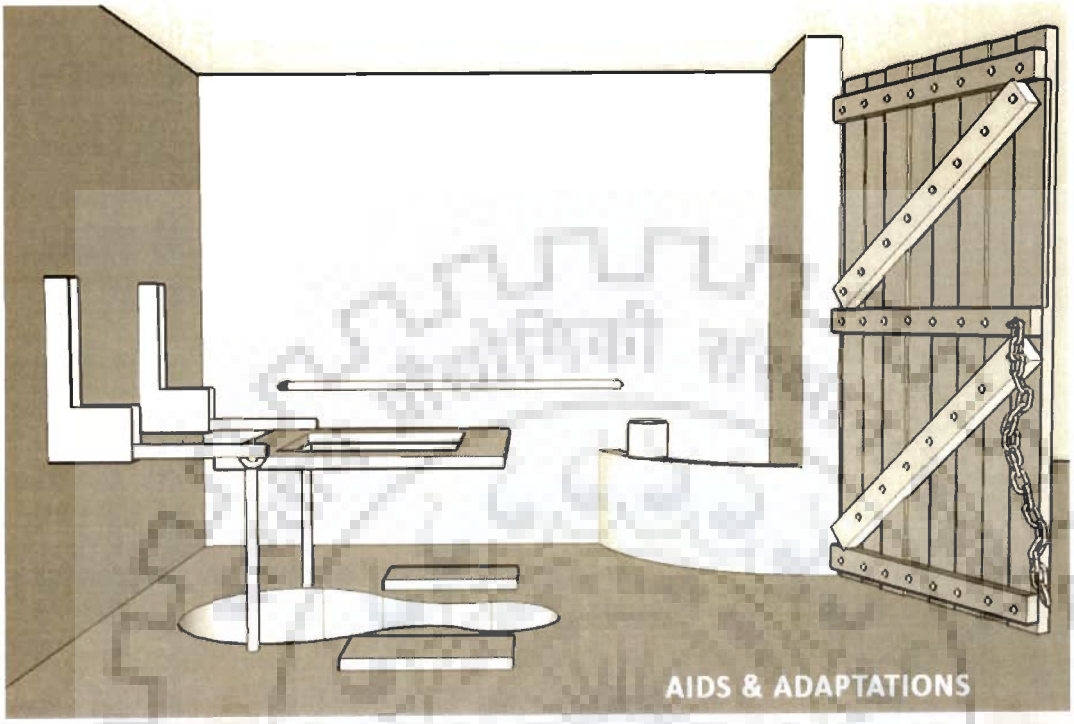


Fig. 5.107 Aids and Adaptations for Toileting (Inside space view)

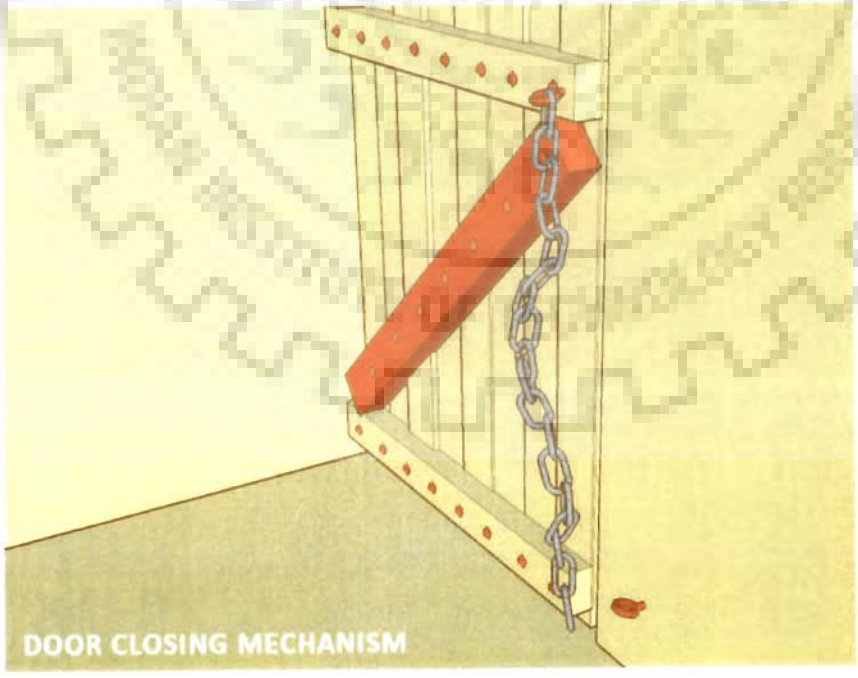


Fig. 5.108 Battened Door with an iron chain

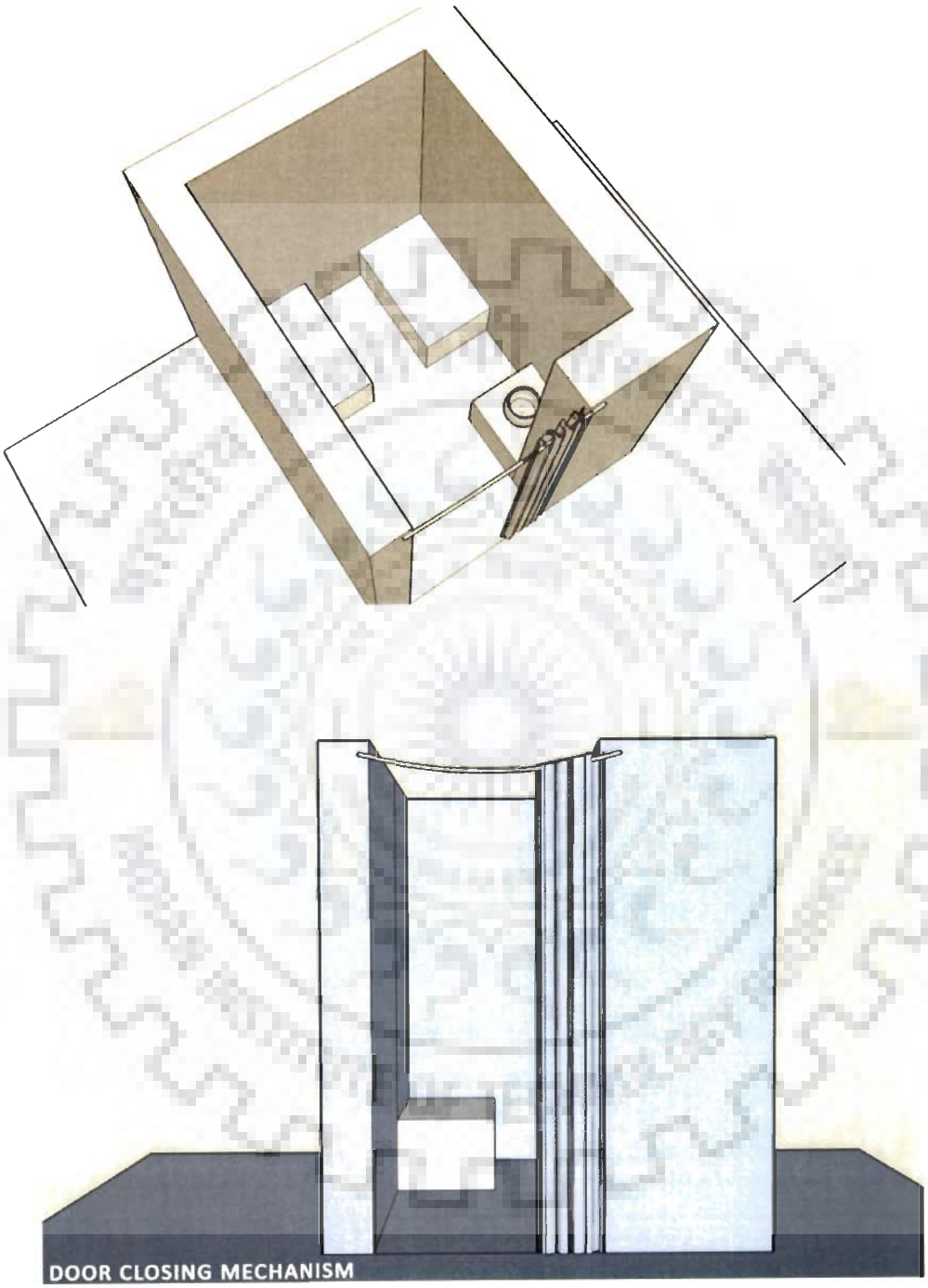


Fig. 5.109 Curtain door for privacy as a low cost alternative

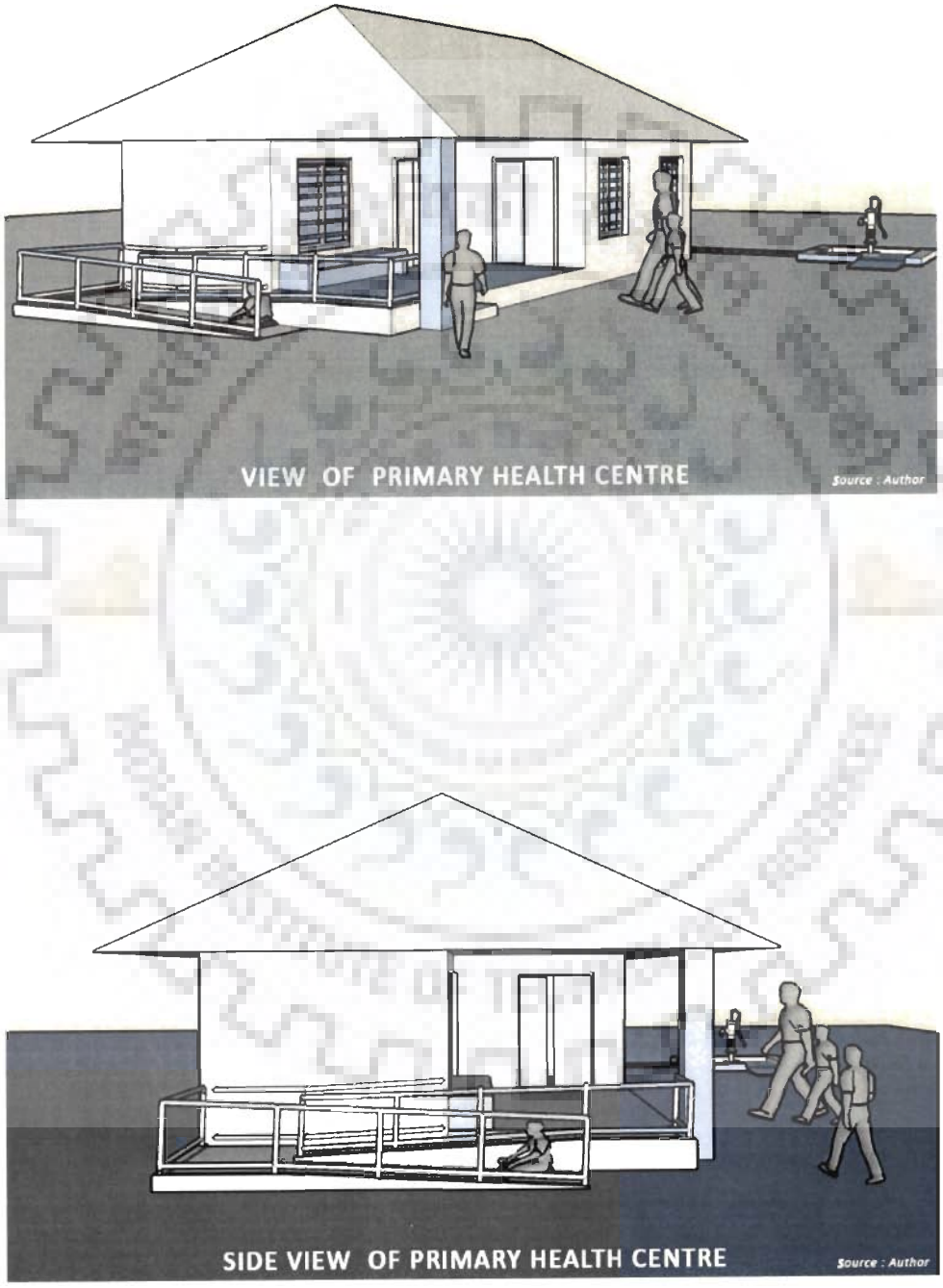


Fig. 5.110 Front and side views of an Accessible Rural Health Centre showing the integration of a gradual sloping ramp in design.

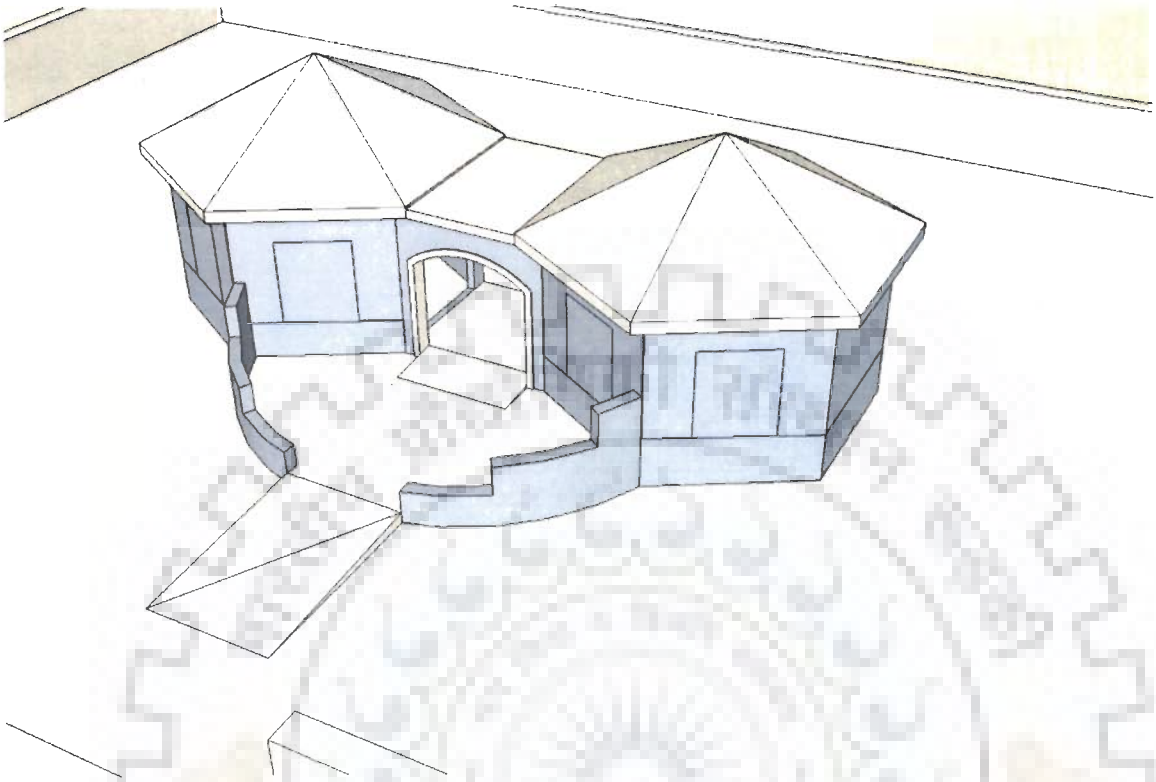
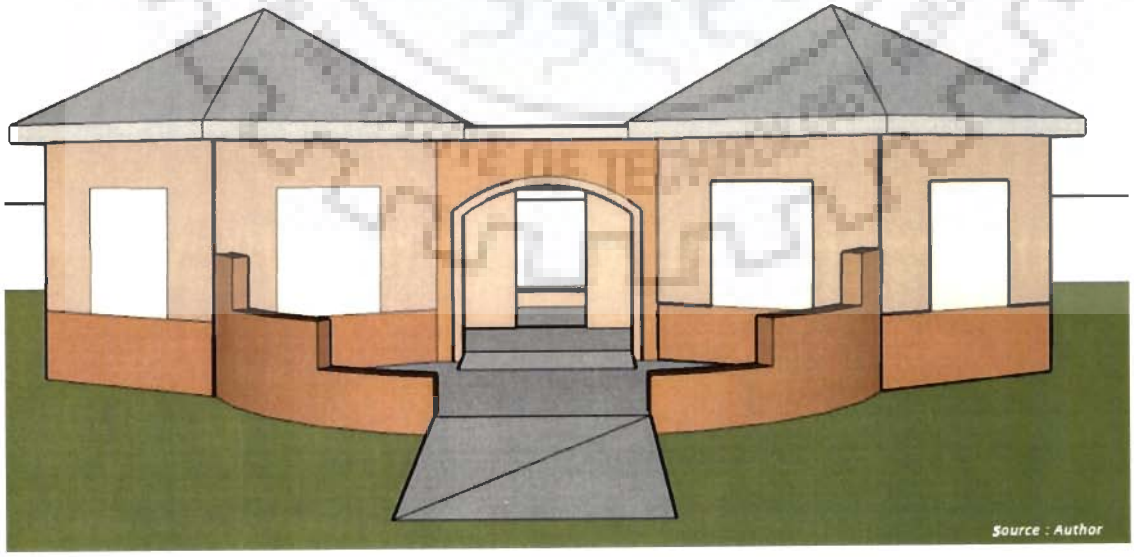
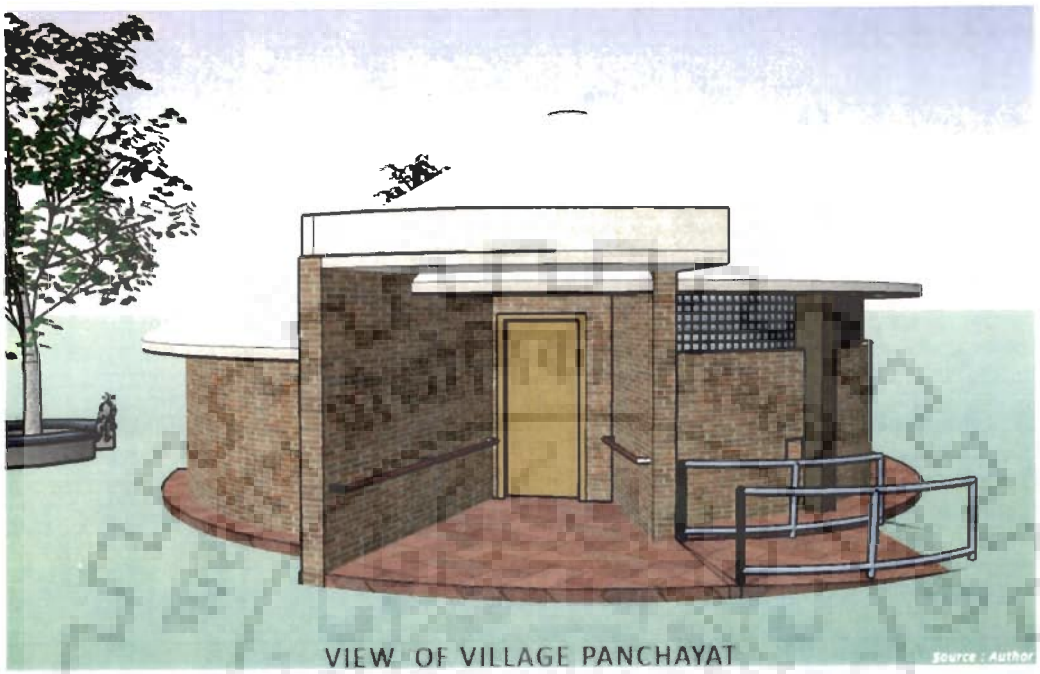


Fig. 5.111 Rural Primary School



VIEW OF ANGANWADI | RURAL PRIMARY SCHOOL



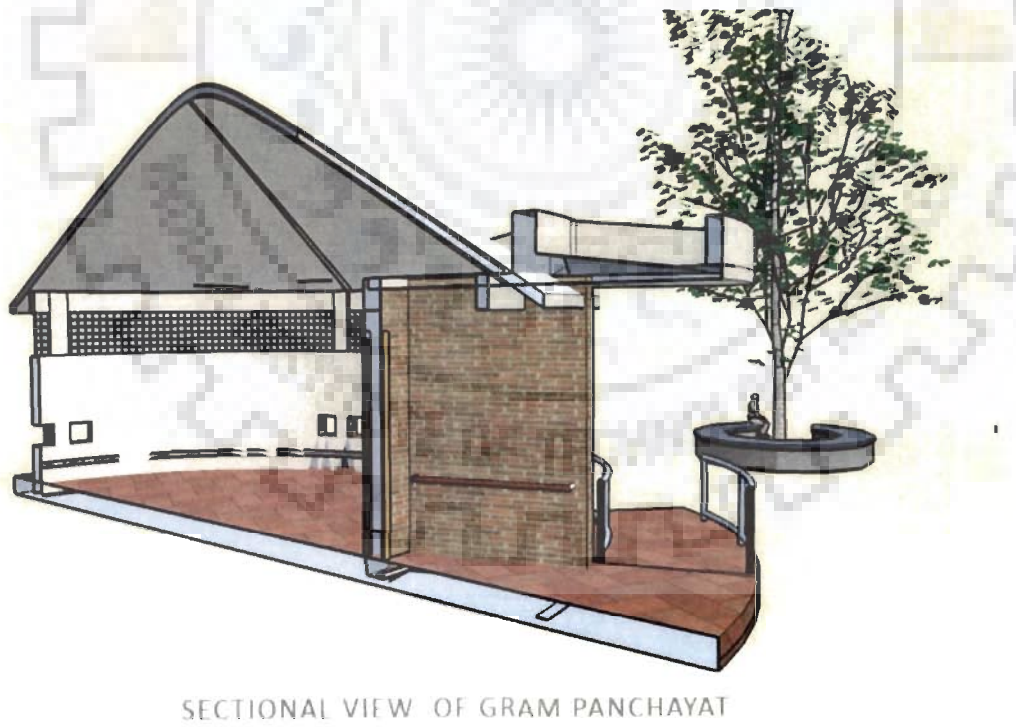


Fig. 5.112 Sectional and Front Views of a Village Panchayat Ghar

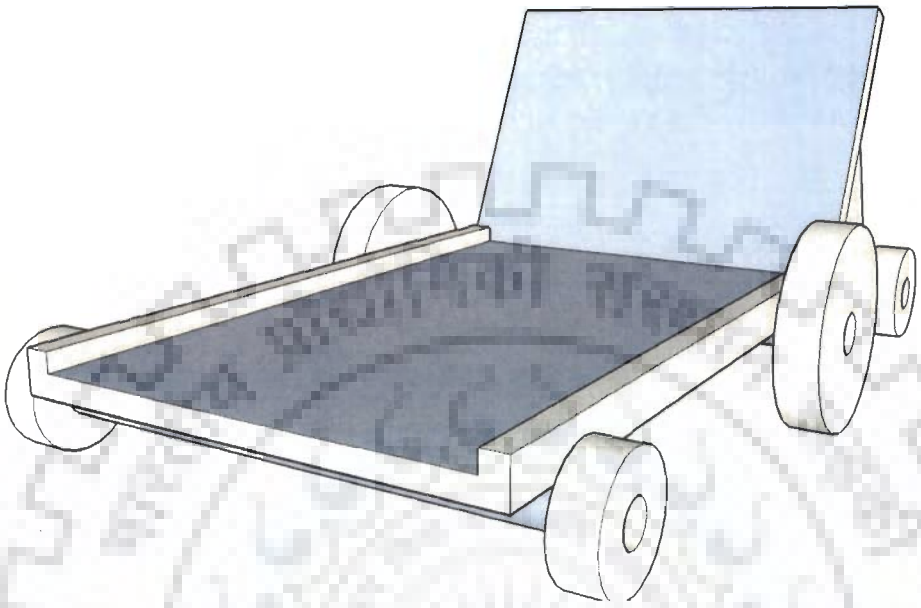


Fig. 5.113 Ground Mobility Device

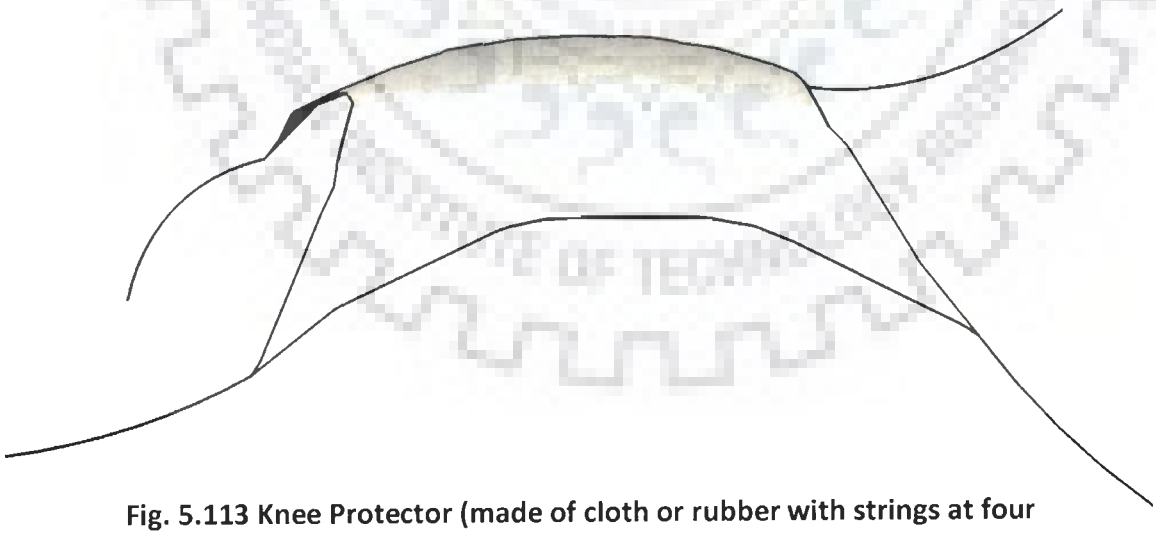


Fig. 5.113 Knee Protector (made of cloth or rubber with strings at four ends) for the non ambulant (who crawl to move)

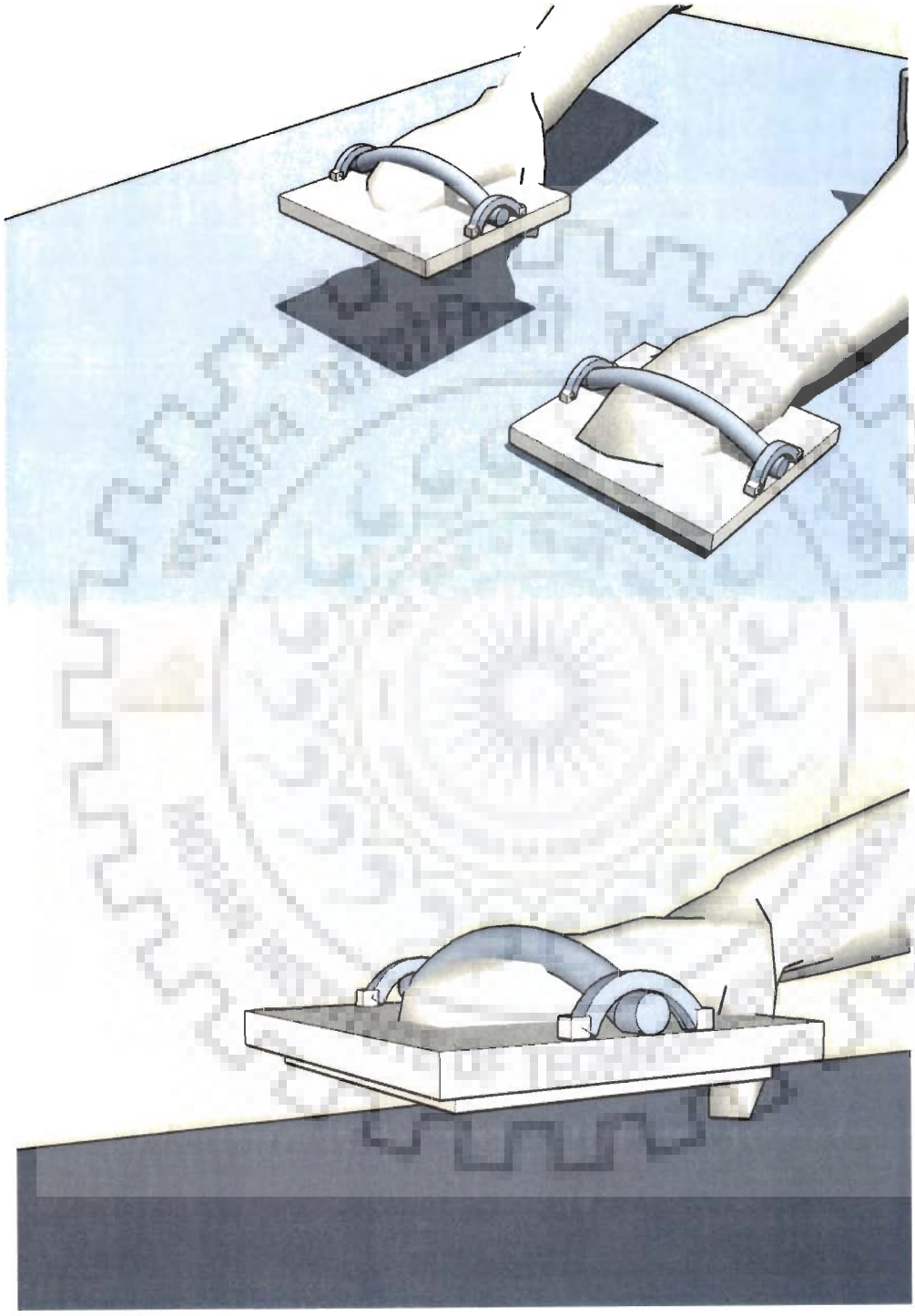


Fig. 5.114 Wooden Hand gripper with rubber padding for the non ambulant (who crawl)

5.11 THEORETICAL MODELS

The study of performance of Activities of Daily Living by the mobility impaired persons in the rural environments was conducted under tedious data collection frameworks. However, it was able to gather relevant information with an active participation of the survey participants in the study area. Diverse activities were simulated by the participants in their natural environments. Based on their factual response, qualitative observations and open ended discussions, it was clearly evident that the functioning of ADLs in their environments was a result of complex interactions between the personal limitations and environmental factors which is presented in the form of a graphical representation in Fig.5.103. Termed as a theoretical model of understanding, it shows a two way interlinking between the Activities of Daily Living, the Personal characteristics and the Environmental Characteristics in which the activity is performed. As was observed through activity analysis and specific case studies presented for each activity, the ultimate functioning of an ADL by an individual is a function of his individual capacities (derived from his personal characteristics like age, gender, socio demographic aspect, degree of disability etc.) and the environmental characteristics viz. the physical barriers, social and institutional frameworks.

It intends to highlight that the ultimate aim is to improve the performance of ADLs by the mobility impaired persons, two possible directions of approach are available. One is to enhance the individual limitations through medical interventions. However, still many other parameters like age, gender, degree of disability etc. could not be changed. Another possible approach would be to make environmental design interventions and modifications which are external to an individual's body. A synergy of medical inputs along with environmental changes can truly result in the integration of people with mobility limitations into daily life activities.

Diverse activity performances of mobility impaired persons were studied in their natural environment settings. Personal limitations due to impaired functioning of limbs was no

doubt found to be a limiting factor, yet the emphasis was to explore critical barriers to access, participation and integrated living in their own environments. Personal limitations were either beyond control or could be controlled through awareness building in addition to medical and assistive technology intervention while Environmental factors could be intervened through strategic design and planning approaches.

Fig. 5.115 Theoretical Model of Understanding

To transform a disabling environment into an enabling framework, it would require a comprehensive approach to be developed. A holistic picture of the functioning of mobility impaired people in the rural environs was seen in this study along with a complex network of physical and social interactions that may further impair or facilitate their living. Environmental design interventions to promote access in rural environments is one of the key directions that this thesis proposes as a step towards integration of people with mobility impairments in the rural areas. However, there is a strong realization that creating access is not an end in itself. It is a means for inclusion. Social and economic inclusion of people with mobility impairments in the rural environments is a challenging task. Dependency is a huge task, and as a study on independent living in the US concludes:

" Keeping disabled people in dependency is costing many times more than would helping them to independence. To do nothing on the basis that our ability to respond to the problem is constrained by the inflation is to feed that inflation and further reduce our capacity to solve and vastly exceed the cost of spending to make the disabled independent." (Bowe,1980:203)

A model framework for implementation to create accessible rural environments as a beginning to enablement for people with disabilities, is thus proposed (Fig. 5.115). The key tenet of this framework is to improve access at a high priority to basic sanitation facilities, education and health facilities extending to social participation (especially in village decision making). Besides them, there is a strong need to strengthen the vocational rehabilitation programme along with promoting development of appropriate assistive technology. To make the model of implementation self sustainable, a participatory approach becomes necessary along with a three tier framework viz. at the individual level, community level and the government level wherein responsibilities are shared at each level. It shall require to build awareness at community level to understand accessibility as a step towards inclusion.

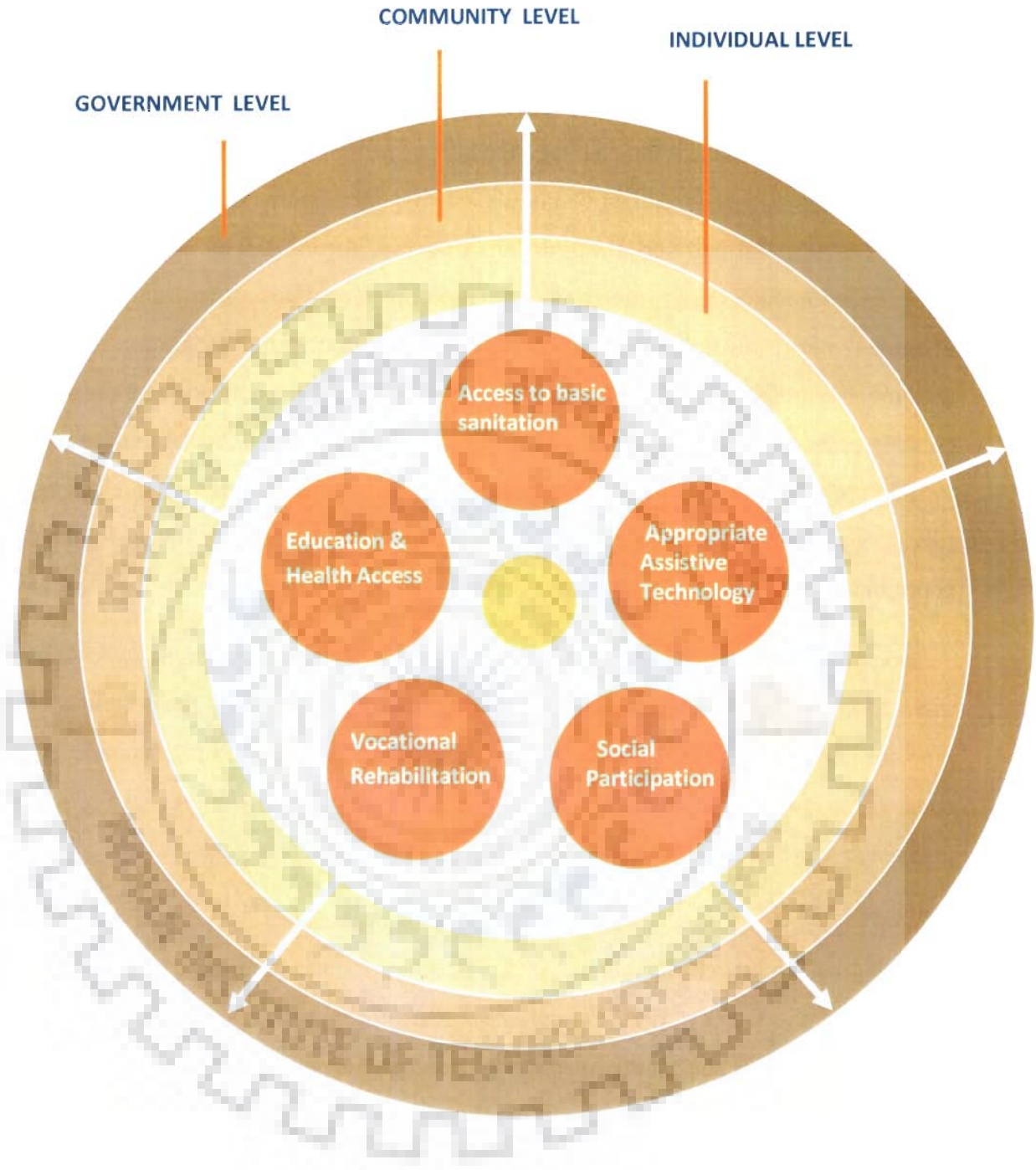


Fig. 5.116 Model of Implementation

5.12 CONCLUSIONS

A detailed analysis of the performance of Activities of Daily Living by the survey participants in their rural environments has been discussed in this chapter. Their perceptual experiences about the degree of difficulties in the performance of ADLs were rated on a five point unipolar scale. Various activities were simulated by the survey participants and their steps were photo documented for better understanding and analysis. Qualitative views of the respondents are also presented in this chapter. The barriers and facilitators were identified and discussed individually in the various sections on different ADLs. The major emphasis of this chapter was on gaining insight about the issues related to performance of self care activities. Based on the understanding of various problems as encountered by the participants and suggestions in the form of discussions with the participants, their family members and members of the community, conceptual design solutions are proposed with an aim to build their prototypes in a model accessible village for further testing. Towards the end, this chapter synthesizes a theoretical model of understanding between the various parameters and concludes with suggesting a holistic model of implementation for integrating the mobility impaired persons in the rural environments into mainstream activities with a larger aim to improve their quality of lives.

Chapter 6

CONCLUSIONS & RECOMMENDATIONS

Whilst still in the stages of developing a reasonable ground for theory, this study draws attention to the integration of mobility impaired people in the rural environments through enabling their built environments. This could be done either by making accessible designs of spaces or by making simple changes to increase adaptability of the existing infrastructure designs. As a part of the research findings, it was felt that accessibility is a means to opportunity for greater participation and involvement in life through ADLs. The degree of accessibility provided through the infrastructural support at physical level, social support and attitudinal support would enhance a disabled (mobility impaired) person's potential to self sustenance in economic and social terms. In the absence of any accessibility framework at rural levels, it is strongly felt that accessibility provisions must in some way be encouraged. Though, the extent of study was limited to a small homogeneous sample for a qualitative investigation, it contributes to the methodological framework for pursuing further research in this area. The larger intent of the thesis to integrate the people with disabilities into the mainstream could possibly be contributed through an established dialogue between persons with disabilities (mobility impairments in this case) and the researchers. Enablement through environmental designs, assistive technology and reducing information gaps could make a huge contribution in improving access to basic infrastructure facilities, education, health and employment in a rural, low income community environment. This would also be a step towards providing dignity and reducing poverty for the people with mobility impairments.

6.1 CONCLUSIONS

Based on the review of literature, survey and case study analysis based findings, the following conclusions can be drawn :

1. Disablement Process is a complex process of interaction between person and his environment. While focus on an individual, leads to a medical model based thinking, design based interventions at environment level can essentially lead to a social model based approach

2. Non availability of primary data at grass root levels, lack of standard methodological process to conduct accessibility research in naturalistic settings and gaps between policy and practice were identified as some of the research gaps in the field. While the magnitude of the problem is quite large, this area of research has received very little attention by research groups.

3. Evidences to support the theory of cyclic relationship between poverty and disability were found. It was found through the survey that most persons with mobility impairments in rural environments, belonged to low economic status owing to reduced access to employment and other opportunities.

4. Rehabilitation preferences of the respondents with mobility impairments were discussed with the participants as to know their perceptions about the same. Economic concerns were found to be a major concern among the survey participants and their family members. As a result, much demand for vocational rehabilitation was realized in contrast to an existing medical based rehabilitation approach.

5. Family support was found to be critically important and a positive element in the socio cultural aspect of the study area with almost all survey respondents (except one) experiencing a high quality of human support and care giving

through their families. Though, amongst the family members, the major concern felt was about the future of the disabled member in their family.

6. There was found to be a lack of proper toileting and bathing facilities in low income communities of rural environments. The one's that are available are inappropriately designed and constructed for users with mobility impairments, or are dangerous though there also exist few examples which facilitate easy performance of their activities.

7. Various barriers and facilitators to access the environment were identified, which could hinder or facilitate the performance of ADLs by the persons with mobility impairments in the rural environments.

8. While an extensive literature was searched and reviewed, guidelines for promoting access in the rural environments could not be found. While, a significant information on design guidelines for creating barrier free environments at urban levels exists, no such document was available for reference to the agencies responsible for the implementation of infrastructural provisions at rural level.

9. Activities of self care demand greater attention for access including access to water source as one of the areas of prime concern. Also, it was realized that benefits of accessible sanitation facilities both at individual and community level would reduce the burden of care givers in a significant way.

10. The general belief that achieving accessibility requires high level technical expertise and funding needs to be challenged. It was realized through the feedback discussions that imported solutions which may be out of context might definitely be expensive and might not be culturally appropriate as well. Thus, based on the researcher's understanding through the study and inputs from

discussions with the mobility impaired respondents, several conceptual design solutions along with recommendations are proposed.

11. While the domain of this research majorly deals with environmental design interventions to improve access for the performance of ADLs, the need for appropriate assistive technology in the form of aids and adaptations was largely felt which can enhance their functioning in a significant way. Few examples of indigenously created mobility devices were found in the study area which facilitate their mobility in their environments.

12. The field of accessibility research, particularly the accessibility issues at a low income group community level in rural settings in a developing country like India, lacks a strong theoretical base. It thus becomes imperative to develop and share some knowledge in this area so as to make some progress in the areas of enablement and rehabilitation of persons with disabilities (mobility impaired) in the rural environments. In that light, the thesis proposes a model of understanding and implementation through graphical representation.

6.2 RECOMMENDATIONS

Though the extent of problem is quite large in its magnitude, it needs to be continuously redressed through multidisciplinary perspectives to ensure a holistic coverage and a wider impact. The following recommendations as an outcome of this study lay a strong emphasis on design based modifications in the existing rural environments and also suggest a shift in approach from the medical model to the social model towards integrating the people with mobility impairments (and other disabilities) into mainstream.

1. In the absence of reliable database about the location of people with mobility impairments in the rural areas, it would be very difficult to initiate accessibility programmes at a larger scale. Process to identify of people with movement and other disabilities needs to be strengthened with strong documentation of database.

2. It requires to view the person – environment interactions with a larger aim of addressing issues of integrating the persons with mobility impairments in the Activities of Daily Living. Thus, addressing barriers only as individual limitations and limiting to the physical environments will prove ineffective unless the social and institutional frameworks are not supportive.

3. There is an urgent need to develop accessibility design guidelines and a code of practice for rural environments to promote access into the rural infrastructural facilities for improved performance in ADLs and better participation in other domains. This shall not only reduce the burden of the caregivers but also provide a self esteem to the mobility impaired in the rural environments.

4. Awareness programmes with the help of NGOs and community support to adopt a supportive role in creating access by maintaining spaces can become a positive tool for ensuring accessibility as a sustainable concept.

5. Documentation of best practices and indigenously created solutions (for mobility devices and adaptable environments)at grass root levels in the rural environments, shall become a useful aid for implementation of ideas with a wide reach to cross cultural domains.

6. Information documents for the local implementing agencies need to be developed which need to be complemented by training and awareness programmes. Also, sharing information with village communities through discussions accompanied by demonstrations would be an effective medium

owing to a highly prevalent cultural practice of talking and listening rather than reading and writing.

7. The concept of model accessible village through local community support needs to be implemented at Pilot level in few chosen districts of the region before extending to at a large scale of implementation. Only after channelizing the three tier framework (as proposed in the model of implementation) at individual, community and government level success to create inclusion in a holistic sense could be achieved. Moreover, small areas of application would further inspire similar projects to be widely applicable.

8. There needs to be a better mechanism to control check over the implementation of the schemes to the farthest extent. Transparency in the mechanism could be built in by regular administrative checks and feedbacks from the persons with disabilities and their family members.

9. Rural environments need simplified solutions to access yet relevant to their socio cultural contexts. As a result, there is a need for further research to develop accessibility design solutions through a participatory approach based on universal design approach and yet have scope for adaptability to local customs. The broader aim through design interventions also is to debunk the prevalent myth that persons with mobility impairments need special or separate facilities for performing ADLs. Funding through international agencies (like United Nations) must be sought for the same.

10. Access to educational facilities coupled with strong attitudinal and institutional support in the villages for diversity of mobility impaired individuals should become a necessary mandate rather than a optional one. This shall encourage children with restricted mobility and their family members to participate in the learning process for their own development.

11. Development of cost effective appropriate technology for assistive devices needs attention for enhancing the functional capacities of mobility impaired. Also, certain alternative design solutions could be incorporated in the indigenously developed solutions developed by the mobility impaired people themselves. This can then catalyze the implementation of these devices into their lifestyle. For example, a indigenously created mobility device as shown in Fig. 4.20 acts is developed in cast iron. As a result, it is very heavy to lift and also gets too hot and cold in the external weather conditions prevalent in the region, which makes it difficult to grip. Alternatively, a similar device could be manufactured in bamboo as a light weight material which shall not only reduce the cost but also the effectiveness and usability of the device.

12. Vocational rehabilitation could be extended through outreach programmes in order to impart vocational skills to the persons with mobility impairments. This can be further extended to generation of self employment schemes.

13. Prevention of disabilities (like the Pulse Polio vaccination programme)must continue hand in glove with other programmes for enablement of persons with mobility impairments. Though, medical interventions are beyond the scope of this study, it was observed through the survey that there is a high prevalence of mobility impairments most of which are due to poliomyelitis virus. Preventing the spread of this virus thus becomes a paramount recommendation so as to reduce the number of persons with limited mobility at a larger scale.

6.3 SUGGESTIONS FOR FURTHER RESEARCH

While the work presented in this thesis may be envisaged as a contribution to the methodological directions involved in the understanding and creation of enabling environments for mobility impaired in the rural areas , some areas have been identified which need further research investigations. It is hoped that the methodological framework developed and the qualitative data reported in this research study will assist

future investigators to advance accessibility research to greater dimensions. Following are the suggested areas for further research :

- Development of a valid and reliable assessment instrument to measure person-environment interactions in the naturalistic settings.
- To make better generalizations for planning or design recommendations, it would be appropriate to conduct similar studies on a larger and heterogeneous sample.
- Documentation of good exemplars of access in low income, rural communities across regional variations and social diversities shall provide insight into research for developing cross culturally adaptable designs and improving upon them.
- The proposed conceptual designs for various infrastructural facilities, as an outcome this study need to be built as a prototypes at pilot study level and then field tested with the mobility impaired subjects in their living environments.
- The methodological framework as developed in this study may be extended to gather insight into the needs of people with other disabilities and determine barriers and facilitators to their performance of ADLs.

Research promotion for design initiatives shall lead to better designs with a wider acceptance rather than design interventions with no research base which may with best of the intentions may still create barriers. Integration of universal design issues at rural levels to develop an inclusive community could form the basis for future research.

REFERENCES

Alexander, Christopher, 1970, Notes on the Synthesis of Form, Harvard University Press, Cambridge, Massachusetts.

Al-Zoabi, A.Y., 2001. A strategic design of accessible buildings for people with a disability in Jordan. Architectural Science Review, Volume 44, pp 181-186.

Aygun, M., Comparative performance appraisal by multiple criteria for design alternatives. Architectural Science Review, Volume 43, pp 31-36.

Avlund, K., Damsgaard, M.T., Rantala, R.S., Laukkanen, P., Schroll, M., 2002. Tiredness in daily activities among nondisabled old people as determinant of onset of disability. Journal of Clinical Epidemiology 55 (2002) 965 – 973.

Accessibility Planning : What it can achieve ? Chapter 7 of *Wasted Time : The Price of Poor Access – Employment Sector (Philipines)*

Balaram, S., 1999. Design and Disability. National workshop 5-6, August 1999.

Balaram, S., 2001. Universal design and the majority world. In W.F.E. Preiser, & E.Ostroff (Eds.), Universal Design Handbook. Ch. 5, pp. 5.1 – 5.20

Balram, S., 2004, Better accessibility for women and the elderly, presented at National Seminar on Barrier Free Environment for the Persons with Disabilities and the Elderly, Kolkata, India.

Barman, Jaydip, 2004, Improving Urban Legibility and Design for Barrier Free Environment, presented at National Seminar on Barrier Free Environment for the Persons with Disabilities and the Elderly, Kolkata, India.

Barnes, C., Mercer, G., Shakespeare, T., 2003. Exploring disability – a sociological introduction, Polity press, UK.

Barton, Len, 1989, Disability and Dependency, The Falmer Press, London.

Bednar, Michael, J., 1977, Barrier Free Environments, Dowden, Hutchinson & Ross, Inc., Community Development Series, Volume 33, Pennsylvania.

Banerji, Haimanti, Barman, Jaydip, Sengupta, B.K., 2007, Reestablishing the role of socio psychological factors towards development of a holistic barrier free environment for the users with impaired mobility, Spatio-Economic Development Record, Vol.14,No.2, pp. 31-38.

Banerji, Haimanti, Barman, Jaydip, Sengupta, B.K., 2006, Addressing Psycho-Physical Barriers towards creation of practical responsive environment for persons with impaired mobility: Case study of Indian Railway Stations. Proceedings of the First National Conference on Mobility for All, New Delhi organized by Samarthya and TRIPP, IIT Delhi.

Banerjee, Kaushik. Gary hlady, W. Andrus, Jon. Sarkar, Sobhan. Fitzsimmons, John & Abeykoon, Palitha. ,2000, Poliomyelitis surveillance: the model used in India for polio eradication, Bulletin of the World Health Organization, Vol. 78, (3): 321-329.

Barret, J., 2005. Support and information needs of older and disabled older people in the U.K. Applied Ergonomics 36 (2005) 177-183.

Barnes, C., 1997. Disability and the myth of the independence researcher. In 'Disability studies: Past present and future' *(Eds.)* Barton, L., Oliver, M. Leeds: the disability press, pp. 239 - 243.

Bhatia, Gautam, 1991, Laurie Baker : Life, Work, Writings, Viking/ Hudco

Best, R., 2001. Lifetime homes: Achieving accessibility for all. In W.F.E. Preiser, & E.Ostroff (Eds.), Universal Design Handbook. Ch. 14, pp. 14.1 – 14.14

Bowe,F. (1980) Rehabilitating America: Towards Independence for Disabled and Elderly people, New York, Harper and Row.

Bradtmiller, B., Anthropometry for persons with disabilities: needs in th twenty-first century. RESNA 2000 Annual Conference Research Symposium – Ergonomics: An emerging technology for increasing participation in work and daily living.

Butler C, 1986, Effect of powered mobility on self-initiated behaviours of very young children with locomotor disability. Developmental Medicine and Child Neurology, 28:325-332, 1986.

Cai, D., You, M., 1998. An ergonomic approach to public squatting- type toilet design. Applied Ergonomics Vol 29, No 2, pp 147 – 153, 1998.

Chandra, Satish, Sihag, Bharathi Sivaswami, 2000, Rural Housing in India : Problems and Prospects, Ministry of Rural Development, Government of India.

Chakrabarti, Debkumar, 1997. Indian Anthropometric dimensions – for ergonomic practice. National Institute of design, Ahmedabad.

Cochrane, Mathew, 2001, Taal Mael – a Centre for Architectural Research and Development Project Report for DFID.

Cooper, B.A., Letts, L., Rigby, P., Law, M., Stewart, D., Strong, S., 1999. Selecting person – Environment assessment. Theory as a basis for research on enabling environments. In E.Steinfeld & G.S.Danford (*Eds.*), Enabling Environments –Measuring the impact of environment on disability and rehabilitation.Ch. 17, pp. 373 – 398.

CRP, 2002, Response to research questionnaire. Centre for the Rehabilitation of the Paralysed, Savar, Dhaka, Bangladesh.

Clegg, Chris, W., 2000, Sociotechnical principles for system design, Applied Ergonomics, 31 (2000), pp 463 – 477.

Christophersen, J., 2001. Accessible housing in five European countries: standards and built results. In W.F.E. Preiser, & E.Ostroff (Eds.), Universal Design Handbook. Ch. 13, pp. 13.1 – 13.14

Charlton, J.I., 1998. Nothing about us without us – Disability oppression and empowerment. University of California Press, United States of America.

Chakravarthy, P.N., 2001, Design of toilet facilities for physically handicapped,Unpublished M.Des. dissertation, Industrial Design Centre, Indian Institute of Technology, Bombay, India.

Conell, B.S., Stanford, J.A., 1999. Research implications of universal Design. Theory as a basis for research on enabling environments. In E.Steinfeld & G.S.Danford (*Eds.*), Enabling Environments –Measuring the impact of environment on disability and rehabilitation. Ch. 2, pp. 35-55.

Curtis, S., Gesler, W., Smith, G., Washburn, S., 2000. Approaches to sampling and case selection in qualitative research: examples in geography of health. Social Science & Medicine 50 (2000) 1001 – 1014.

Costa, L.J.A., Massad, E., Ortega, N.R.S., Araujo, 2001. Estimation of the degree of functional disability through a fuzzy model. IEEE 459 – 463.

Danford, G. S., Steinfeld, E., 1999. Measuring the influences of physical environments on the behaviors of people with impairments. Theory as a basis for research on enabling environments. In E.Steinfeld & G.S.Danford (*Eds.*), Enabling Environments – Measuring the impact of environment on disability and rehabilitation. Ch. 5, pp. 111-139.

Das, B., Kozey, J.W., 1999. Structural anthropometric measurements for wheelchair mobile adults. Applied Ergonomics 30 (1999) 385-390.

Davis, K., 1990. A social barriers model of disability: Theory into practice, *the emergence of the "Seven Needs"*. Paper for the Derbyshire coalition of disabled people.

Deverill, P., Bibby, S., Wedgwood, A. and Smout, I.,2002 Designing water supply and sanitation projects to meet demand in rural and peri-urban communities. Book 3: Ensuring the Participation of the Poor. WEDC, Loughborough.

Dijkum, C., 2001. A methodology for conducting interdisciplinary social research. European Journal of Operational Research 128 (2001) 290 – 299.

Dolan, C, Concha, ME and Nyathi, E, 1995, 'Community rehabilitation workers: do they offer hope to disabled people in South Africa's rural areas?', International Journal of Rehabilitation Research, Vol.18, 3, pp.187-200.

Drake, R.F., 1999. Understanding disability policies. Palgrave Macmillan Press Ltd, London.

Desai, Arvindrai N., 1995, Helping the Handicapped : Problems and Prospects, Ashish Publishing House.

Deshpande, S. Prosthetic Engineer and Head, Department of Prosthetics and Orthotics, All India Institute of Physical Medicine and Rehabilitation. Personal Communication.

Erb S. and Hariss-White B., 1999, Adult Disability, Poverty and Downward Mobility: The Macro and Micro Picture from India; Paper presented to the Development Studies Association Annual Conference, 13th September 1999, University of Bath.

Friedmann, A., Zimring, C., Zube, E., 1978. Environmental Design Evaluation. Plenum Press, New York.

Gibbs, D., 1999. Disabled people and the research community. Papers for ESRC, 'Theorising Social work Research', seminar 2, 'Who owns the research process?' Belfast, September 1999.

Goldsmith, S., 2001. The bottom-up methodology of universal design. In W.F.E. Preiser, & E.Ostroff (Eds.), Universal Design Handbook. Ch. 25, pp. 25.1 – 25.16

Goldsmith, S., 1967. Designing for the disabled. Mc Graw-Hill Book Company, Great Britain

Gray, David, 2004, Developing the ICF E Codes: a new research agenda to map environments as context for participation, Advancing a research agenda for ICF.

Greed, Clara, 2003, Inclusive Urban Design : Public Toilets, Architectural Press, Oxford.

Helander, E., & Mendis, P., et al.,1983, Training disabled people in the community. Geneva: WHO.

Helander, E, 1999, Prejudice and dignity : an Introduction to Community Based Rehabilitation. Second Edition, UNDP:New York.

Hetherington, H., Earlam, R.J., Kirk, C.J.C., 1995. The disability status of injured patients measured by the functional independence measure (FIM) and their use of rehabilitation services. Injury Vol. 26, No.2, pp. 97 - 101, 1995.

Hotchkiss, R. , 1990, Third World Wheelchair Manufacture: Will It Ever Meet the Need? RESNA 13th Annual Conference, Washington, D.C., pp.309-310.

Hussein, Hazreena, 2005, Encouraging a barrier free built environment in a Malaysian University, Journal of Design and the Built Environment, Vol.1,No.1, pp 33 – 39.

Hussain, M.G., 1982, Problems and Potentials of Handicapped, Atlantic Publishers, New Delhi.

Hoving, J.L., O'Leary, E.F., Niere, K.R., Green, S., Buchbinder, R., 2003. Validity of the neck disability index, Northwick Park neck pain questionnaire, and problem elicitation technique for measuring disability associated with whiplash –associated disorders. Pain 102 (2003) 273 – 281.

Imrie, R., Hall, P., 2001. Inclusive design – Designing and developing accessible environments, Spon Press, London.

Iwarsson, S., Isacsson, A., 1999. "The enabler" Applied to occupational therapy: Reliability of a usability rating scale. Theory as a basis for research on enabling environments. In E.Steinfeld & G.S.Danford (*Eds.*), Enabling Environments –Measuring the impact of environment on disability and rehabilitation. Ch. 4, pp. 93-108.

Jackson, Clare M., 2000, Domestic Water Supply and Sanitation Facilties for the physically disabled living in Low income rural and urban communities of developing countries, Water, Engineering and Development Centre (WEDC), Loughborough University, Loughborough, Leicestershire.

Jafry, T., O`Neill, D.H., 2000. The application of ergonomics in rural development: a review. Applied Ergonomics 31 (2000) 263 – 268.

Joint Position Paper, 1994, Community based rehabilitation for and with people with disabilities. International Labour Organization, United Nations Educational, Scientific & Cultural Organization, World Health Organization.

Jones, H, Parker, K J, Reed, R., 2002, Water Supply and Sanitation access and use by physically disabled people, Literature Review report, DFID Contract No. R 8059.

Jones, Hazel, Reed, R., 2002, Water Supply and Sanitation access and use by physically disabled people, Inception report, DFID Contract No. R 8059.

Jones, Hazel, Reed, R., 2003, Supply and Sanitation access and use by physically disabled people, Reports of fieldwork in Cambodia, Bangladesh, Uganda, DFID Contract No. R 8059.

Kalyanpur, M (1996) 'The influence of Western special education on community-based services in India', Disability & Society, Vol.11, 2, pp. 249-270.

Komardjaja, I and Parker, K J ,2001, Mobility and accessibility for elderly women in developing Asian countries, Ageing International, Summer, pp.20-26. International Federation on Ageing: Montreal, Canada.

Krippendorff, K , 1980, Content Analysis: An Introduction to its Methodology Sage, London.

Kruger, R., 1988, *Focus Groups: A practical guide for applied research*, London: Sage.

Kumar, S., 1992, Rehabilitation. An ergonomic dimension. International Journal of Industrial Ergonomics, 9:97-108.

Lantrip, D.B., 1999. Measuring constraints to inhabitants Activities. Theory as a basis for research on enabling environments. In E.Steinfeld & G.S.Danford (*Eds.*), Enabling Environments –Measuring the impact of environment on disability and rehabilitation. Ch. 6, pp. 139-163.

Leandro Despouy, 1993, Human rights and Disabled Persons (Study Series 6), Centre for Human Rights Geneva and UN New York.

Lewis C and Sygall S. (eds.), MIUSA 1997.Loud, Proud and Passionate; Including Women with Disabilities in International Development Programmes.

Lewis, I, Jones, Hazel, Reed, R., 2002, Water Supply and Sanitation access and use by physically disabled people, e conference synthesis report, DFID Contract No. R 8059.

Lifchez, R., Winslow, B., Design for independent living – the environment and physically disabled people. The Architectural press, Ltd. London.

Luck, R., 2003, Dialogue in participatory design, Design Studies, 24(2003), pp 523-535.

Mace, Ronald, Hardie,, G.J., Place, Jaine P., 1991, Accessible Environments : Towards Universal Design, Van Nostrand Reinhold.

Mazumdar, S., Geis, G., 2001. Interpreting Accessibility standards: Experiences in the U.S. Courts. In W.F.E. Preiser, & E.Ostroff (Eds.), Universal Design Handbook. Ch. 18, pp. 18.1 – 18.20

Metts, R L ,2000, Disability Issues, Trends and Recommendations for the World Bank. World Bank: New York.

Meyers, Allan R., Anderson, Jennifer J., Miller, Donald R., Shipp Kathy, Hoeing, Helen, 2002, Barriers, facilitators, and access for wheelchair users : substantive and methodologic lessons from a pilot study of environmental effects, Social Science & Medicine, Pergamon, Vol.55, pp 1435 – 1446.

Miles, S., 1999, Strengthening Disability and Development Work. Discussion Paper. BOND Disability and Development Working Group, UK.

Misra, S.K., 1973, Egalitarian Principle and Housing, The Indian Architect, Bombay.

Misra, S.K. 1973, Research in Architecture, Journal of Indian Institute of Architects, Bombay.

Molenbroek, J.F., 1987, Anthropometry of elderly people in the Netherlands; research and applications. Applied Ergonomics, 18(3):293-301.

Mulholland, SJ, Packer, TL, Laschinger, SJ, Olney, SJ and Panchal, V ,1998, 'The mobility needs of women with physical disabilities in India: a functional perspective', Disability & Rehabilitation, Vol.20, 5, 168-178.

Mulholland, S.J., Lysack, J.T., Packer, T.L., 1996, Collecting data in a developing country, RESNA'96 Proceedings, pp 157.

Mulholland, S.J., Packer, T.L., Laschinger, S.J., Lysack, J.T., Wyss, U.P., Balram, S., 2000, Evaluating a new mobility device : feedback from women with disabilities in India, Disability and Rehabilitation, Vol. 22, No. 3, pp. 111 – 122.

Mullick, A., 2001. Universal Bathrooms. In W.F.E. Preiser, & E.Ostroff (Eds.), Universal Design Handbook. Ch. 42, pp. 42.1 – 42.24

Muhlenberg A.L.and LeBlanc, M.A. 1988, Body-powered upper-limb components. In D. J. Atkins and R.H. Meier (eds.), Comprehensive Management of Upper-Limb Amputee. Springer-Verlag

Munda, G., 2003. Social multi-criteria evaluation: Methodological foundations and operational consequences. Eurpean Journal of Operational Research xxx (2003) xxx-xxx

Narayan D., 1995, The Contribution of People's Participation. World Bank.

Narasihan, M.C., Mukherjee, A.K., 1996. Disability – A continuing Challenge. Wiley Eastern Limited, NewDelhi.

Nowak E. , 1996, The role of anthropometry in design of work and life environments of the disabled population. International Journal of Industrial Ergonomics, 1996; 17: 113-121.

Nevala-Puranen N, Sorensen L. Physical strain and work ergonomics in farmers with disabilities. Int J Occup Safety Ergon 1997; 3: 77-88.

Oliver, M., 2002. Emancipatory Research: a vehicle for social transformation or policy development. For 1st Annual disability research seminar, Hosted by the national disability authority and the centre for disability studies, university college Dublin.

Oliver, M., Emancipatory research: realistic goal or impossible dream? In *(Eds.)* Barnes, C., Leeds, G.M., Doing Disability research. Ch. 2, pp. 15-31.

Ostroff, E., 2001. Universal design: The new paradigm. In W.F.E. Preiser, & E.Ostroff (Eds.), Universal Design Handbook. Ch.1, pp. 1.3 - 1.12. McGraw-Hill, New York.

Parakattel, Paul, 1991, Creating accessibility in developing countries, Report of the CIB Expert Seminar on Building Non Handicapping Environments, Budapest.

Parsons, K.C., Shackel, B., 1995, Ergonomics and International Standards: History, Organizational structure and method of development, Applied Ergonomics, Vol. 26, No. 4, pp 249 – 258.

Parker, K.J., 2001. Developing economies: A reality check. In W.F.E. Preiser, & E.Ostroff (Eds.), Universal Design Handbook. Ch. 32, pp. 32.1 – 32.11

Packer, T. (1994), Research Notes. Low-level short- range mobility devices in developing countries. CASMA December 1994, p.4.
Petzall, Jan., 1996. Traversing step obstacles with manual wheelchairs, Applied Ergonomics Vol 27, No.5, pp. 327 – 341.

Ponnuswami, Ilango, 1996 Situation of Older Persons in India, Ageing Research Foundation of India, S.India.

Preiser, W.F.E., 2001. Towards Universal design evaluation. In W.F.E. Preiser, & E.Ostroff (Eds.), Universal Design Handbook. Ch. 9, pp. 9.1 – 9.18

Ray, Amit, 2005, Design Paradigm : A New Approach in Ergonomics Study, Proceedings of International Ergonomics Conference , HWWE 2005, Indian Institute of Technology, Guwahati, India.

Reuterswärd, Lars, 1995, Design for Easy Access to Buildings by Physically disabled persons, Building Issues, Volume 7, Number 4.

Robb, G.M., 2001. Guidelines for Outdoor areas. In W.F.E. Preiser, & E.Ostroff (Eds.), Universal Design Handbook. Ch. 20, pp. 20.1 – 20.22

Robinson, J.W., Thompson, T., 1999. Stigma and Architecture. Theory as a basis for research on enabling environments. In E.Steinfeld & G.S.Danford (*Eds.*), Enabling Environments –Measuring the impact of environment on disability and rehabilitation. Ch. 11, pp. 251-270.

Rimmer, J.H., Riley, B., Wang, E., Rauworth, A., Jurkowski, J., 2002. Physical Activity participation among persons with disabilities, Barriers and Facilitators. American Journal of Preventive Medicine, 2004; 26(5), pp 419 - 425.

Sethi PK., 1989, Technological choices in prosthetics and orthotics for developing countries. Prosthetics and Orthotics International;13: 117± 124.

Steinfeld, E., Danford, G.S. (Eds.), Measuring Enabling Environments. Kluwer Academic/Plenum, New York.

Stone J,H. The international transfer of appropriate assistive technology. Technology and Disability 1993; 2: 15± 18.

Strauss, A and Corbin, J ,1997, Grounded Theory in Practice Sage, London.

Saha R, Dey AK, Hatoj M, Poddar S. Study of wheelchair operations in rural areas covered under the District Rehabilitation Centre (DRC) scheme. Indian Journal of Disability and Rehabilitation 1990; July± Dec.: 75± 87.

Sandhu, J., 2001. An integral approach to universal design : towards the inclusion of all ages, culture, and diversity. In W.F.E. Preiser, & E.Ostroff (Eds.), Universal Design Handbook. Ch. 3, pp. 3.3 – 3.14

Sandhu, J.M., Jansen, H.H., Environmental design for handicapped children, Saxon house.

Sanford, J.A., Megrew, M.B., 1999. Using environmental simulation to test the validity of code requirements. Theory as a basis for research on enabling environments. In E.Steinfeld & G.S.Danford (*Eds.*), Enabling Environments –Measuring the impact of environment on disability and rehabilitation. Ch. 8, pp. 183-205.

Sanford, Jon A., 1996, A Review of Technical Requirements for Ramps, *Final Report for U.S. Access Board [Contract No. QA930020]*

Sanford, Jon A., 2001, Best Practices in the Design of Toileting and Bathing Facilities for Assisted Transfers, *Final Report for U.S. Access Board*

Salvage, A., Zarb, G., 1995. Measuring Disablement in Society. Gaining access: Disabled people and the physical environment.

Sen Lalita, Banerji, Haimanti, 2004. Barriers to Accessible Transportation and Access in Urban India : A Case Study of Kolkata, Proceedings of TRANSED 2004, The 10th International Conference on Mobility & Transport for Elderly & Disabled People, Hamamatsu, Japan, May 23-26, pp 70 – 79.

Sen, Lalita, 2006. A way to enhance accessibility and increase safety for the disabled in urban India. Proceedings of the First National Conference on Mobility for All, New Delhi, TRIPP, IIT Delhi and Samarthya.

Sen, Lalita, 2006. Accessible Tourism in India. Proceedings of the First National Conference on Mobility for All, New Delhi, TRIPP, IIT Delhi and Samarthya.

Sekulski, R., Jones, L., Pastalan, L.A., 1999. A day's journey through life: An assessment game. Theory as a basis for research on enabling environments. In E.Steinfeld & G.S.Danford (*Eds.*), Enabling Environments –Measuring the impact of environment on disability and rehabilitation. Ch. 9, pp. 211-230.

Singh, Rajat S., 2003, Design of Wheelchair, Unpublished M.Des. dissertation, Industrial Design Centre, Indian Institute of Technology, Bombay, India.

Sorensen, R.J., 1979. Design for accessibility. McGraw-Hill Book Company, United States of America.

Shinde, P, 2003, Systems Technology in Design , Proceedings of AICTE Sponsored Short Term Course on Green Architecture organized by Quality Improvement Programme Cell, JNTU, School of Planning and Architecture, Hyderabad, India.

Singh, B.K., 2004, Barrier Free Considerations for Rural Environment, Proceedings of National Seminar on Barrier Free Environment organized by Ministry of Social Justice and Empowerment at Kolkata.

Steinfeld, E., Danford, G.S., 1999. Theory as a basis for research on enabling environments. In E.Steinfeld & G.S.Danford (*Eds.*), Enabling Environments –Measuring the impact of environment on disability and rehabilitation. Ch. 1, pp. 11-33. Kluwer Academic / Plenum Publishers, New York.

Story, M.F., 2001. Principles of Universal design. In W.F.E. Preiser, & E.Ostroff (Eds.), Universal Design Handbook. Ch. 10, pp. 10.3 – 10.19

Strauss, E., Torres, H.A., Kareholt, I., Winblad, B., Fratiglioni, L., 2003. Women are more disabled in basic activities of daily living than men only in very advanced ages: A study on disability, morbidity, and mortality from the Kungsholmen Project. Journal of Clinical Epidemiology 56 (2003) 669 – 667.

Schultz, I.Z., Crook, J., Meloche, G.R., Berkowitz, J., Milner, R., Zuberbier, O.A., Meloche, W., 2004. Psychosocial factors predictive of occupational low back disability: towards development of return-to-work model. Pain 107 (2004) 77-85.

Suen, Ling S., 2006. Essential Components for an Ideal Accessible Community. Proceedings of the First National Conference on Mobility for All, New Delhi.

Voordt, T.J.M., 1999. Space requirements for accessibility: Cross-Cultural Comparisons.

Theory as a basis for research on enabling environments. In E.Steinfeld & G.S.Danford (*Eds.*), Enabling Environments –Measuring the impact of environment on disability and rehabilitation.Ch. 3. pp 59-87.

Van der Kroft M., 2002, Response to research questionnaire, Overseas Disability Adviser, Save the Children/UK.

Werner, D., 1999. Disabled village children – A guide for community health workers, rehabilitation workers, and families. The Hesperian foundation, Berkeley, CA.

W.H.O., 2001, ICF - International Classification of functioning, disability and health.W.H.O, Geneva.

Willett, J., Deegan, M.J., 2001. Liminality and disability rites of passage and community in hypermodern society. Disability studies quarterly, summer 2001, volume 21, no.3, pages 137-152.

Wijk, M., 2001. The Dutch struggle for accessibility awareness. In W.F.E. Preiser, & E.Ostroff (Eds.), Universal Design Handbook. Ch. 28, pp. 28.1 – 28.17

Wolfenson J., Poor Disabled and Shut out. Speech at World Bank 'Disability and Development Conference' 3.12.02. www.worldbank.org/wbi/BSPAN/ docs/wolfensohn_op_ed_120302.pdf

World Bank , The World Bank and Disability: Including People with disabilities, 2001. Website: http://wbln0018.worldbank.org/HDNet/Hddocs.nsf/

World Health Organization, 1979, Science and technology for health promotion in developing countries: WHO Chronicle ; 33: 399± 406.

World Disability Report, 1999.

Zarb, G., 1995. Modelling the social model of disability. Critical Public Health, Vol.6, No.2, 1995.

APPENDIX I A

SURVEY SCHEDULE

I. PERSONAL PARTICULARS

1. Name :
2. Age :
3. Gender : (Male / Female)
4. Village :
5. Educational Status :

   Illiterate / Can Read only / Can Read and Write only / Primary School / Middle School / High School / Other (specify)
6. Religion : Hindu / Muslim / Sikh / Christian / Other (specify)
7. Caste :
8. Marital Status : Married/ Unmarried

II. HOUSEHOLD PARTICULARS

9. Type of Family : (Joint / Nuclear)
10. No. of members in the family: Adults – (Male ...../ Female.....)

    Children – (Male...../ Female.....)
11. Relationship with the household head : Self / Child / Brother / Sister / Other (specify)

III. SOCIO ECONOMIC PARTICULARS

12.Type of house : Kutcha / Pucca

13. Total Plinth Area :

14.Material of Construction : Roof .....

Walls .....

Flooring .....

15. Electric Supply : (Yes / No)

If yes, how efficient is the power supply ? .

16. Water Supply : (Piped / Personal Hand Pump / Community Hand Pump)

17. Toilet Facility (within home) : (Yes / No)

18. Bathing Facility (within home): (Yes / No)

19. Occupation : Unemployed / Agriculture / Daily wager / Self Employed / Service / Others

20. Family Income :

21. Self Perceived Economic Status :

IV. DISABILITY PARTICULARS

22. Type of Disability : (Ambulant / Non ambulant).....

23. Cause of Disability : (Natural / Unnatural).....

24. Since when are you having this disability : .....

25. Degree of Mobility : (No mobility / Mobility restricted to house only / Mobillity upto neighbourhood / Mobility within the village / Mobility upto city)

26. Category of locomotor disability : (Ambulant / Non Ambulant)

27. Mobility device being used : (Walking Stick / Crutches / Walking Frame / Wheel chair / Tricycle / Any other device.....)

28. Disability Certificate : Yes / No

V. POSTURAL LIMITATIONS

29. Indicate your Perception of Postural Limitations in the table given below :

S.No.	Postural Limitation		Remarks
1	Standing		
2	Squatting		
3	Sitting Crosslegged		
4	Bending		

(1-Very Difficult, 2-Difficult, 3-Neither difficult nor easy , 4- Easy, 5-Very easy)

VI. REHABILITATION SUPPORT

30. Have you received any rehabilitation support from the Govt.? (Yes / No)
31. If yes, What is the form of that support ? [Medical Aids / Mobility devices / Other (specify) .....]
32. Have you received any form of Community Based Rehabilitation ?

33. Rate the rehabilitation preferences as per your perception

S.No.	Rehabilitation Preferences	Preference	Remarks
1	Medical Support		
2	Environmental Design Support		
3	Vocational Rehabilitation		
4	Economic Support		
5.	Social/Attitudinal Support		

(1-Very High, 2-High, 3-Neither high nor low , 4- Low, 5-Very Low)

Note : This survey is being conducted by Mr. Gaurav Raheja, Ph.D. Scholar , Department of Architecture and Planning, IIT Roorkee and will be used exclusively for academic purposes.

APPENDIX I B

Semi Structured Interview on ACTIVITIES OF DAILY LIVING

Domains of Interaction	Description / Questions / Key words for discussion
Mobility	Mobility device used
Moving distances	Sequence of activities
Climbing	Perceptual Experience Rating [PER] about the level of ease
Transfer Activity	difficulty in performing that activity. **(1-Very Difficult, 2-Difficult, 3-**
Self Care	**Neither difficult nor easy , 4- Easy, 5-Very easy]**
Fetching water	Felt the need of access before ?
Toileting	Space where the ADL is performed. Who else uses it ?
Bathing	During extreme weather conditions like rain etc. ?
Occupation	Perception of distance – very far to very close
Education	Issues involved
Household work	Barriers Faced
Employment	Reachability, Accessibility, Usability, Safety, Privacy, Adaptability
Social Participation	Gender Appropriateness, Cultural acceptability
Leisure activities	Cost, affordability
Friendship networks	Suggestions for improvements ?
Family support system	Human Assistance – Care givers
Health Status	Feelings associated
Religious participation	Government based support
	Other possible adaptations
	Need for an assistive device
	Materials availability
	Need for access
	Personal Experiences related to the ADL

APPENDIX II A

CODING SHEET FOR DATA ANALYSIS

PhD Thesis Title : Enabling Environments for the Mobility Impaired in Rural Areas

S.No.	Variable Name	var	OPTIONS						
			1	2	3	4	5	6	Remarks
PERSONAL PARTICULARS									
1.	Name	nam							
2.	Age	age	< 12 yrs	12 – 25 yrs	25 - 45 yrs	>45 yrs			
3.	Gender	gnd	Male	Female					
4.	Village	vill	Village name						
5.	Education	edu	Illiterate	Primary	Secondary	High School	Graduation	Vocational	
6.	Religion	rel	Hindu	Muslim					
7.	Caste	cast	Lower Caste	Middle Caste	Upper Caste				
8.	Marital Status	mar	Single	Married	Widowed	Divorced			
9.	Family Type	fam	Nuclear	Joint					
10.	Household size	size	Less than 5	5 – 10 members	More than 10				
11.	Relationship with household head	head	Self	Father /Mother	Husband/Wife	Son/Daughter	Any Other		
SOCIO ECONOMIC PARTICULARS									
12.	Type of House	hsetyp	Kutcha	Semi Pucca	Pucca				
13.	Roofing	roof	Thatch / Battened	Jack Arch	RBC	RCC			
14.	Walling	wall	Mud Brick	Unplastered Brick	Plastered Brick				
15.	Flooring	floor	Mud Flooring	Brick Coba	PCC				
16.	Electric Supply	elec	Yes	No					
17.	Water Supply in the house	wtsup	Community Hand Pump	Own Hand Pump	Piped				
18.	Toilet Facility within home	toi	Yes	No					
19.	Occupation	occu	Unemployed	Agriculture	Daily Wager	Service	Self Employed		
20.	Self Perceived Economic Status	eco	Totally insufficient resources	Somewhat Lacking	Acceptable	Average	Very Good	Difficult to say	
21.	Family Income (in Rs.) from all sources	inc	< 1000	1000 – 2000	2000 – 3000	3000 – 4000	> 4000		
22.	Cooking Fuel	fuel	Cow Dung/ Fire Wood/Charcoal	Kerosene	LPG				
23.	Vehicle Owned	veh	No Vehicle	Cycle	Motorised Two wheeler	Tractor			
DISABILITY PARTICULARS									
24.	Disability Type	distyp	Ambulant	Non Ambulant					
25.	Disability Cause	disnam	Polio	Paralysis	Injury / Burns/	Any Other			

					Amputation				
26.	Time since Disability	time	< 5 yrs	5 – 10 yrs	> 10 yrs				
27.	Degree of Mobility	dis_mob	Unable to leave home	Immediate vicinity	Within the settlement	To the nearby town			
28.	Mobility Device	dis_mod	No Mobility device	Stick	Crutches	Ground Mobility Device	Wheelchair	Tricycle	
29.	Disability Certificate	dis_cert	Yes	No					
30.	If Yes, Disability Percentage	dis_per	40 – 60 %	60 – 80%	80 – 100 %				
31.	If No, reasons for not getting it made	dis_nil	Totally Unaware	Aware but never made efforts	Made efforts but failed to get				
POSTURAL LIMITATIONS									
32.	Standing	stand	Very Difficult	Difficult	Neither	Easy	Very Easy		
33.	Squatting	squat	Very Difficult	Difficult	Neither	Easy	Very Easy		
34.	Sitting Cross Legged	cross	Very Difficult	Difficult	Neither	Easy	Very Easy		
35.	Bending	bend	Very Difficult	Difficult	Neither	Easy	Very Easy		
36.	Govt. Rehabilitation	rhb_gov	Yes	No					
37.	If yes, then what kinds	rhb_typ	Medical Support	Infrastructure Building	Economic Benefit	Vocational Education			
38.	Community Based Rehabilitation	rhb_cbr	Yes	No					
	If yes, then what kinds								
	Rehabilitation support Preferential Rating								
39.	Medical Support	rhb_ms	Very High	High	Medium	Low	Very Low		
40.	Environmental Design	rhb_ad	Very High	High	Medium	Low	Very Low		
41.	Vocational Support	rhb_infi	Very High	High	Medium	Low	Very Low		
42.	Economic Support	rhb_infc	Very High	High	Medium	Low	Very Low		
43.	Social Integration	rhb_rmb	Very High	High	Medium	Low	Very Low		
	ACTIVITIES OF DAILY LIVING A. MOBILITY								
44.	Walking short distances _PER	wlkshrt_PER	Very Difficult	Difficult	Neither difficult nor easy	Easy	Very Easy		
45.	Walking short distance with some weight _PER	wlkswt_PER	Very Difficult	Difficult	Neither difficult nor easy	Easy	Very Easy		
46.	Walking long distances _PER	wlklng_PER	Very Difficult	Difficult	Neither difficult nor easy	Easy	Very Easy		
47.	Walking long distance with some weight _PER	wlklwt_PER	Very Difficult	Difficult	Neither difficult nor easy	Easy	Very Easy		
48.	Climbing Thresholds _PER	clmbt_PER	Very Difficult	Difficult	Neither difficult nor easy	Easy	Very Easy		
49.	Climbing Stairs _PER	clmbs_PER	Very Difficult	Difficult	Neither difficult	Easy	Very Easy		

					nor easy				
	B. SELF CARE								
	B 1. TOILETING								
50.	Space Location from the house (Distance)	toi_dis	In the house	Very near to house	Quite Far from the house	Very Far from the house			
51.	Space Typology	toi_spc	Open space in the house	Enclosed space (no sanitary fixture(s)) within the house	Enclosed space (with sanitary fixture(s)) In the house	Open Farm			
52.	PER_Toileting	toi_PER	Very Difficult	Difficult	Neither difficult nor easy	Easy	Very Easy		
	B 2. BATHING								
53.	Perceptual distance	bath_dis	In the house	Very near to house	Quite Far from the house	Very Far from the house			
54.	Space Typology	bath_spc	Open space in the house	Enclosed space (no fixture) within the house	Enclosed space (with fixture) In the house	Open Community space			
55.	PER_Bathing	bath_PER	Very Difficult	Difficult	Neither difficult nor easy	Easy	Very Easy		
	C 1. EDUCATIONAL ACTIVITY								
56.	Education Type	edu_typ	Formal	Vocational	Informal (Religious Centre)	Does not go for Education			
57.	Education Location	edu_loc	In the same village	In the nearby village	In the town				
58.	Distance	edu_dis	Very near to house	Quite Far from the house	Very Far from the house				
59.	Space Typology	edu_spc	School in the village	School in nearby village	School in town	Vocational Training Centre in Town			
	C 2. EMPLOYMENT ACTIVITY								
60.	Employment_Type	emp_typ	Self Employed	Employed Outside	Unemployed				
61.	Safety	emp_pri	Very poor	Poor	Fairly Good	Good	Very Good		
62.	Social Support	emp_saf	Very poor	Poor	Fairly Good	Good	Very Good		
	C 3. HOUSEHOLD WORKS – Washing, Cleaning, Cooking								
	D. SOCIAL PARTICIPATION ACTIVITIES (Levels of Satisfaction)								

APPENDIX II B

DATA ENTRY TABLES

	nam	age	gnd	vill	edu	rel	mar	fam	size	head
1	Vikas Kumar	2	1	Bhangeri	3	1	1	2	3	2
2	Raj Kumar	3	1	Bhangeri	4	1	1	1	2	2
3	Azad	2	1	Bhangeri	1	2	1	1	3	2
4	Pankaj (Neetu)	2	1	Bhangeri	3	1	2	1	1	1
5	Sanjay Kumar	2	1	Bhangeri	3	1	1	1	2	2
6	Ram Kishore	2	1	Bhangeri	3	1	1	2	1	2
7	Sushma	2	2	Bhangeri	4	1	1	1	2	2
8	Pinki	2	2	Bhangeri	1	1	1	1	1	2
9	Rekha Rani	2	2	Malakpur	3	1	1	2	3	2
10	Meera Devi	3	2	Malakpur	1	1	1	1	1	2
11	Ravi	2	1	Malakpur	3	1	1	1	2	2
12	Neeraj Kumar	2	1	Malakpur	2	1	1	1	2	2
13	Randheer	2	1	Khanjarpur	4	1	1	2	2	2
14	Muntazeer	2	1	Khanjarpur	3	2	1	1	1	2
15	Shakeela	1	2	Khanjarpur	3	2	1	1	2	2
16	Nazia	1	2	Khanjarpur	1	2	1	1	2	2
17	Momin Ahmed	2	1	Khanjarpur	1	2	1	1	1	2
18	Sattu	2	1	Majra	3	1	1	1	2	2
19	Babli	3	2	Majra	3	1	2	1	2	3
20	Rakesh Kumar	3	1	Majra	3	1	2	1	2	1
21	Shyama Devi	2	2	Majra	3	1	1	2	3	2
22	Ruby	2	2	Majra	3	1	1	2	2	2
23	Pradeep	2	1	Sherpur	4	1	1	1	1	2
24	Sonia	2	2	Sherpur	2	1	1	1	2	2
25	Sandeep	2	1	Sherpur	3	1	1	2	3	2
26	Deepak	2	1	Salempur	1	1	1	1	1	2
27	Rajender	3	1	Salempur	3	1	2	2	2	1
28	Sagar	1	1	Salempur	2	1	1	1	1	2
29	Vinay	3	1	Sunehra	1	1	2	2	2	1
30	Pappu	2	1	Sunehra	1	1	1	1	2	2
31	Pinki	2	2	Sunehra	2	1	1	1	1	2
32	Sandeep	2	1	Sunehra	1	1	1	1	2	2
33	Ganga Ram	4	1	Sunehra	3	1	2	1	2	1
34	Shahjadi	2	2	Rampur	3	2	1	2	2	2
35	Mukul	2	1	Rampur	3	1	1	2	2	2
36	Arvind	3	1	Rampur	3	1	2	2	1	1
37	Shahnaz	1	2	Rampur	2	2	1	2	2	2
38	Israr	4	1	Padli Gujjar	1	2	3	1	1	5
39	Farhat	3	2	Padli Gujjar	1	2	4	1	1	2
40	Mujammel Ahmed	3	1	Shahpur	1	2	2	2	3	1
41	Sadiq	1	1	Rasulpur	1	2	1	2	1	2
42	Saddam	2	1	Rasulpur	3	2	1	2	2	2
43	Shahid	1	1	Rasulpur	2	2	1	2	2	2

	hsetyp	roof	wall	floor	elec	wtsup	toi	bath_fac	occu	eco	inc	catl
1	3	2	3	2	1	3	1	1	6	2	2	2
2	3	4	3	3	1	2	1	1	6	2	5	2
3	3	2	3	3	1	1	1	1	6	2	5	1
4	3	2	3	2	1	2	1	1	4	2	1	2
5	2	2	3	3	1	2	1	1	1	3	5	1
6	3	2	3	3	1	2	1	1	4	2	2	2
7	3	2	3	2	1	2	1	1	6	3	3	2
8	2	2	2	2	2	2	1	1	6	1	2	2
9	3	2	2	2	1	2	1	1	6	3	5	2
10	1	2	2	1	2	1	1	1	1	1	1	2
11	3	2	3	3	1	1	1	1	6	3	5	2
12	2	3	3	1	1	1	1	2	4	2	2	2
13	3	2	3	2	1	2	1	1	4	3	5	2
14	1	1	1	1	2	2	2	2	1	1	2	1
15	2	2	3	1	1	2	1	1	6	3	3	1
16	2	1	2	2	1	2	2	1	1	6	6	1
17	2	2	3	2	1	1	2	2	4	1	1	1
18	2	1	1	1	2	2	2	1	6	1	2	1
19	2	2	2	1	2	2	2	2	1	1	1	2
20	2	2	2	1	2	2	2	2	1	1	1	2
21	2	2	3	1	1	2	2	1	4	6	6	2
22	3	2	3	3	1	2	2	1	6	3	6	2
23	3	4	2	3	1	2	1	1	6	3	2	1
24	3	2	2	1	2	1	2	2	1	1	2	2
25	3	2	3	3	1	2	1	1	4	3	3	1
26	1	1	1	1	2	1	2	1	1	1	1	2
27	2	2	2	1	1	1	2	1	4	2	2	2
28	3	3	2	2	2	2	2	1	6	1	2	2
29	3	2	3	1	1	1	2	2	4	2	2	2
30	2	2	2	1	1	2	2	2	1	1	3	2
31	3	2	3	2	1	1	1	1	4	2	2	2
32	3	2	3	2	1	3	1	1	1	4	5	1
33	3	2	3	3	1	2	1	1	4	4	2	2
34	3	2	3	1	1	1	2	1	6	1	2	2
35	3	2	3	3	1	1	1	1	6	1	2	2
36	2	2	3	2	1	1	2	1	4	1	2	2
37	1	2	1	1	2	2	2	1	6	2	2	2
38	2	2	3	1	1	1	1	1	1	1	2	2
39	1	1	1	1	2	1	2	2	1	2	1	1
40	2	2	3	1	1	2	1	1	4	4	2	2
41	1	1	1	1	1	1	2	1	1	1	2	2
42	2	2	2	1	1	2	1	1	3	3	2	1
43	2	2	2	2	1	1	1	1	4	3	3	2

	dis_type	dis_name	dis_cause	dis_time	dis_mob	dis_mod	dis_cert	dis_per	dis_nil	stand	squat
1	1	1	1	2	2	1	2	.	2	2	1
2	2	1	1	3	1	5	1	2	.	1	1
3	2	1	1	2	1	1	2	.	2	1	2
4	1	1	1	1	2	1	1	1	.	3	2
5	1	1	1	1	3	1	1	1	.	3	2
6	1	3	1	1	2	2	1	3	.	2	1
7	1	1	1	1	3	2	1	2	.	3	2
8	1	1	1	1	2	1	2	.	1	2	3
9	1	1	1	3	2	1	2	.	2	3	2
10	2	1	1	3	1	1	2	.	2	1	2
11	1	1	2	1	2	1	2	.	2	2	2
12	1	1	1	1	3	1	1	2	.	3	2
13	1	1	1	3	3	1	1	1	.	2	1
14	1	1	1	3	2	1	1	2	.	2	1
15	1	1	1	3	3	1	2	.	2	2	2
16	1	1	1	3	3	1	1	2	.	2	1
17	2	1	1	3	1	6	1	3	.	1	1
18	2	1	1	3	1	1	1	3	.	1	2
19	1	1	1	3	3	3	2	.	2	2	2
20	1	3	1	3	3	1	2	.	2	2	2
21	1	1	3	3	3	2	1	1	.	2	2
22	1	1	1	3	3	1	2	.	3	1	1
23	1	1	1	3	3	2	1	2	.	2	2
24	2	1	1	3	1	1	1	1	.	1	3
25	1	1	1	3	2	2	1	2	.	3	2
26	2	1	1	3	1	4	2	.	3	1	1
27	1	3	3	3	2	1	1	1	.	2	2
28	1	1	1	3	2	1	1	2	.	2	2
29	1	1	1	3	4	2	2	.	3	2	2
30	2	1	1	3	3	6	2	.	2	1	1
31	1	1	1	3	2	1	2	.	2	2	2
32	2	1	1	3	2	1	1	3	.	1	1
33	1	3	3	3	3	1	1	2	.	2	3
34	1	1	1	3	2	3	1	3	.	2	2
35	2	3	3	3	2	1	1	3	.	1	2
36	1	1	1	3	2	3	2	.	2	2	3
37	2	2	1	3	2	1	1	3	.	1	2
38	1	1	1	3	1	1	2	.	3	1	1
39	1	3	3	1	1	3	1	2	.	1	1
40	1	3	1	3	4	2	1	2	.	3	2
41	2	1	1	2	1	1	2	.	1	1	1
42	1	1	1	3	3	1	2	.	2	1	1
43	1	1	1	3	3	1	2	.	2	2	1

	cross	bend	rhb_gov	rhb_typ	rhb_cbr	rhb_ms	rhb_ad	rhb_infi	rhb_infc	rhb_rmb
1	3	3	2	.	2	4	2	1	3	5
2	2	1	2	.	2	5	2	1	3	4
3	2	2	2	.	2	3	4	1	2	5
4	4	1	2	.	2	2	3	4	1	5
5	4	2	2	.	2	5	4	1	2	3
6	3	2	2	.	2	4	3	2	1	5
7	3	2	2	.	2	1	3	2	4	5
8	3	2	2	.	2	5	4	3	1	2
9	4	3	2	.	2	5	4	3	2	1
10	3	1	1	2	2	5	3	1	2	4
11	4	2	2	.	2	5	4	2	3	1
12	3	3	2	.	2	5	3	2	1	4
13	3	2	1	1	2	4	3	1	2	5
14	2	2	2	.	2	3	4	1	2	5
15	4	3	2	.	2	5	3	1	4	2
16	3	3	1	1	2	5	4	3	1	2
17	2	2	2	.	2	5	4	2	1	3
18	2	2	1	1	2	2	1	3	4	5
19	1	1	2	.	2	4	2	3	1	5
20	2	2	2	.	2	4	2	3	1	5
21	1	2	1	3	2	5	3	1	2	4
22	2	3	2	.	2	4	3	1	2	5
23	3	3	2	.	2	5	3	1	2	4
24	3	1	2	.	2	3	2	1	4	5
25	2	2	1	4	2	5	3	1	2	4
26	2	2	2	.	2	2	1	3	4	5
27	3	3	2	.	2	4	1	3	2	5
28	3	3	2	.	2	3	4	1	2	5
29	3	2	2	.	2	1	4	3	2	5
30	2	3	2	.	2	2	1	4	3	5
31	3	4	2	.	2	1	4	2	3	5
32	2	2	2	.	2	1	2	3	5	4
33	3	4	2	.	2	3	4	2	1	5
34	3	3	2	.	2	2	4	1	3	5
35	3	4	2	.	2	1	5	2	3	4
36	3	2	2	.	2	3	1	4	2	5
37	3	2	2	.	2	1	3	2	4	5
38	1	1	2	.	2	2	3	5	1	4
39	4	3	2	.	2	4	3	5	1	2
40	4	3	2	.	2	1	3	4	2	5
41	1	1	2	.	2	1	3	4	2	5
42	1	1	2	.	2	2	4	3	1	5
43	4	4	2	.	2	5	2	1	3	4

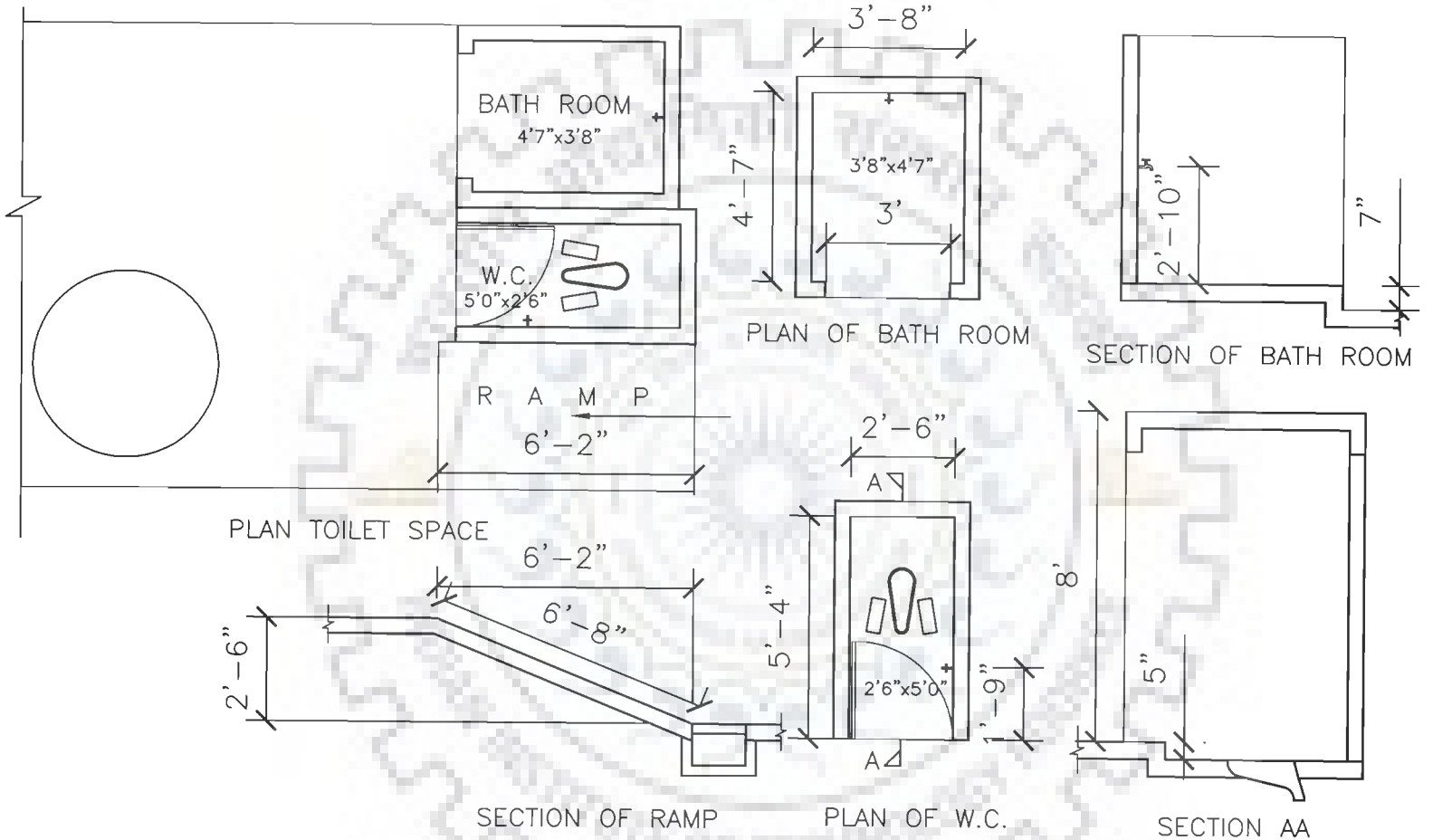
	wlkshrt_PER	wlkswt_PER	wlklng_PER	wlklwt_PER	clmbt_PER	clmbs_PER	fetchwat_PER	toi_dis	toi_spc	toi_PER	bath_dis
1	3	2	1	1	2	1	2	2	3	2	1
2	1	1	1	1	1	1	1	1	3	1	1
3	1	1	1	1	2	2	1	2	3	2	1
4	2	1	1	1	3	2	3	1	3	3	1
5	3	2	2	1	4	3	2	1	3	3	1
6	2	1	1	1	2	1	2	1	3	2	1
7	4	3	3	2	4	3	3	1	3	3	1
8	2	2	1	1	2	2	2	1	3	3	1
9	4	3	2	1	2	2	2	2	3	3	1
10	1	1	1	1	1	1	1	1	3	2	1
11	3	2	2	1	2	2	3	1	3	3	1
12	3	3	2	1	2	2	3	3	4	2	2
13	2	1	1	1	2	2	3	1	3	4	1
14	2	1	1	1	2	1	2	3	4	2	2
15	3	2	2	1	3	2	2	1	3	4	1
16	2	2	1	1	2	1	3	3	4	2	1
17	1	1	1	1	1	1	1	1	2	2	3
18	1	1	1	1	1	1	1	1	3	1	1
19	3	2	1	1	3	1	2	3	4	1	2
20	2	1	1	1	2	1	3	3	4	1	2
21	3	3	2	1	3	2	3	3	4	2	1
22	3	3	1	1	3	2	3	3	4	2	1
23	4	3	2	2	3	2	2	3	4	3	1
24	2	2	1	1	2	2	1	2	4	2	1
25	3	2	1	1	3	3	3	1	3	3	1
26	2	1	1	1	2	1	1	1	1	2	1
27	3	2	2	1	2	1	2	3	4	3	1
28	3	2	1	1	2	2	2	3	4	2	1
29	3	3	2	1	3	2	1	3	4	3	2
30	1	1	2	1	2	1	1	3	4	1	1
31	3	2	1	1	2	2	2	1	3	3	1
32	1	1	1	1	1	1	1	1	3	2	1
33	3	3	2	1	3	2	3	1	3	3	1
34	2	1	1	1	2	1	1	1	2	2	1
35	2	1	1	1	2	1	1	2	2	1	2
36	3	2	1	1	2	2	2	3	4	2	2
37	2	1	1	1	1	1	1	1	2	1	1
38	1	1	1	1	1	1	1	1	3	1	1
39	3	2	1	1	1	1	1	1	2	2	1
40	4	2	2	1	3	2	2	1	3	3	1
41	2	1	1	1	1	1	2	2	2	1	1
42	3	2	2	1	2	1	1	1	2	2	1
43	4	3	2	2	3	2	1	1	2	3	1

	bath_spc	bath_PER	occu_typ
1	2	3	1
2	1	2	1
3	1	2	4
4	3	3	3
5	2	4	4
6	1	3	3
7	2	3	1
8	2	3	1
9	1	2	1
10	2	2	2
11	3	3	1
12	4	3	3
13	2	3	3
14	4	2	1
15	2	3	1
16	1	2	1
17	4	1	3
18	1	1	1
19	1	2	2
20	4	2	3
21	1	3	3
22	2	2	1
23	1	3	1
24	1	2	1
25	3	3	3
26	2	2	4
27	1	2	3
28	1	2	1
29	1	3	3
30	4	2	4
31	2	3	2
32	3	2	4
33	2	3	3
34	2	2	1
35	4	1	1
36	1	3	3
37	2	2	2
38	2	1	4
39	2	2	2
40	2	3	3
41	1	1	4
42	2	3	1
43	2	3	1

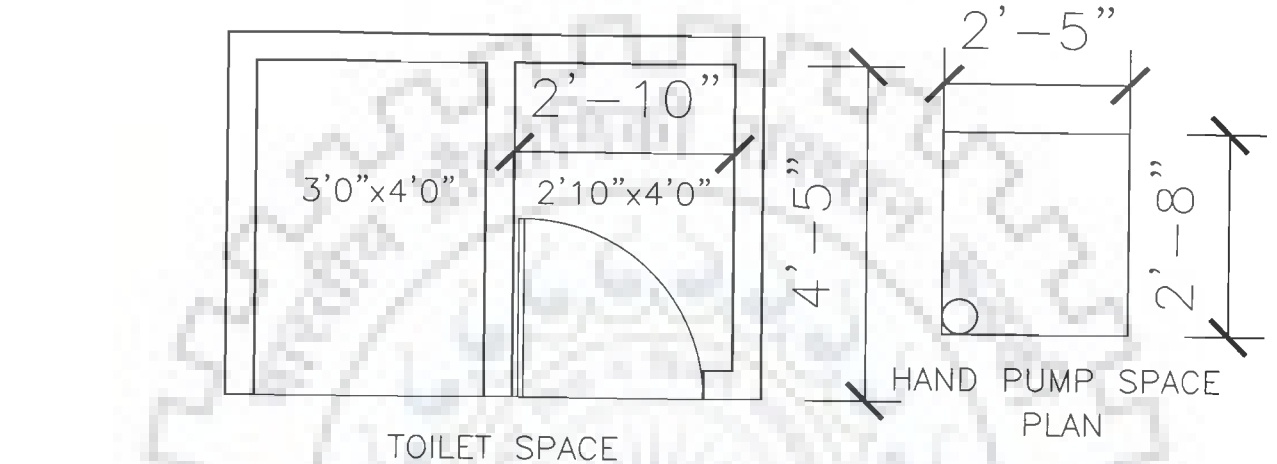
APPENDIX III

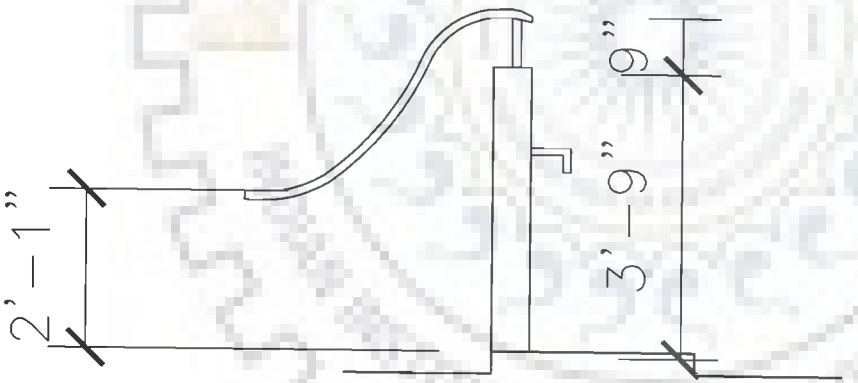
SURVEY MEASURED DRAWINGS

VIKAS KUMAR

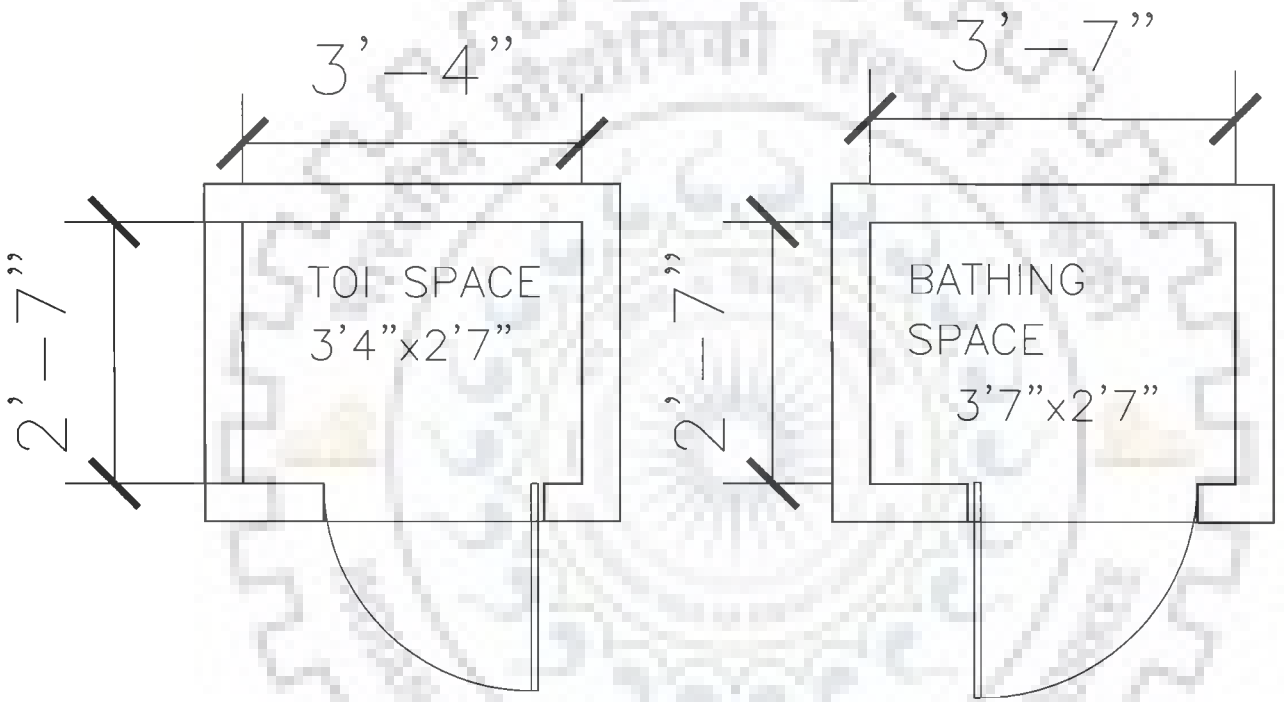


MEASURED DRAWING SURVEY OF TYPICAL RURAL BUILT ENVIRONMENTS	DRAWING TITLE – TOILET SPACE	RESPONDENT NO – 1 NAME – VIKAS KUMAR VILLAGE – BHANGERI MAHAVATPUR

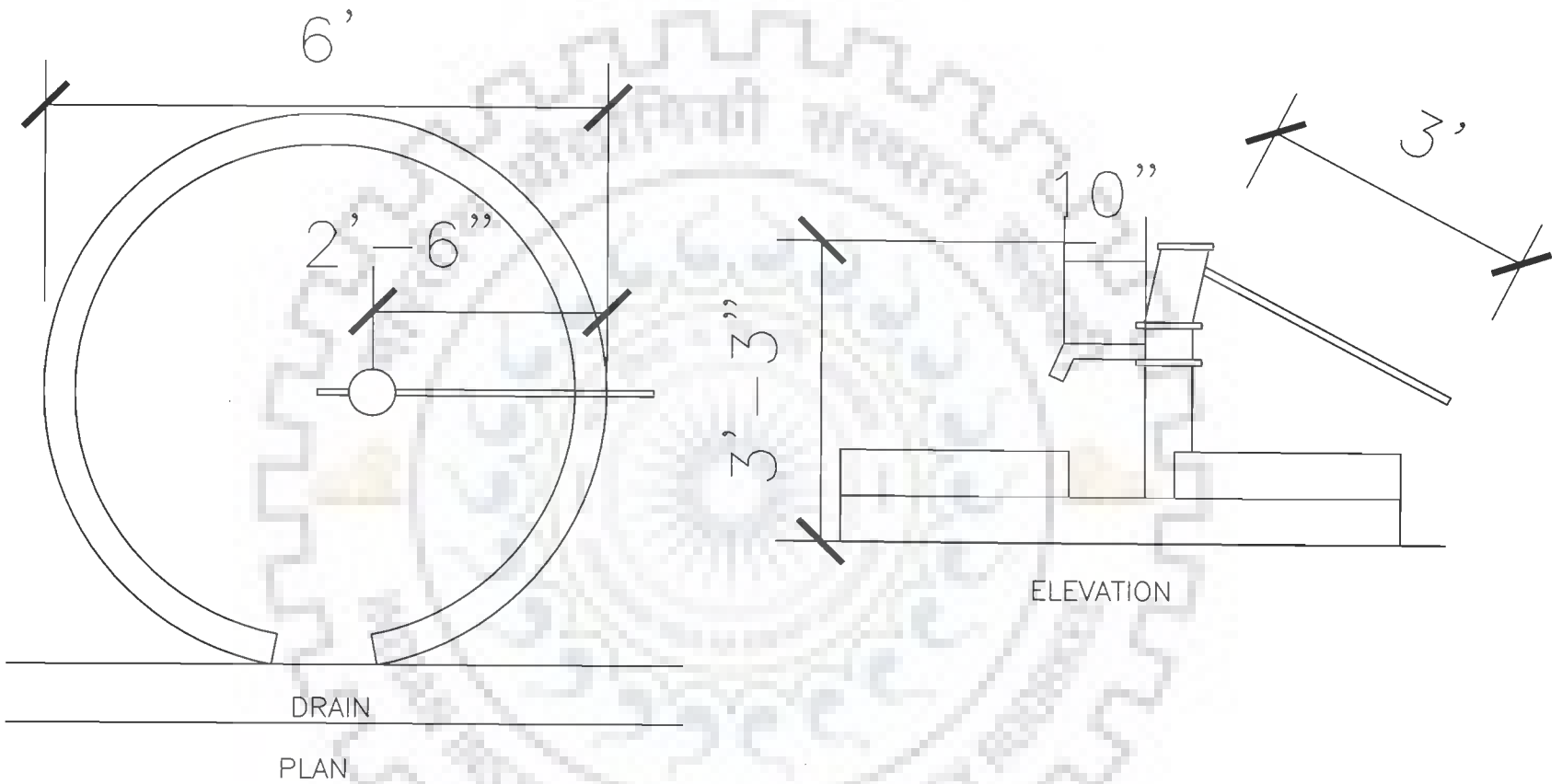




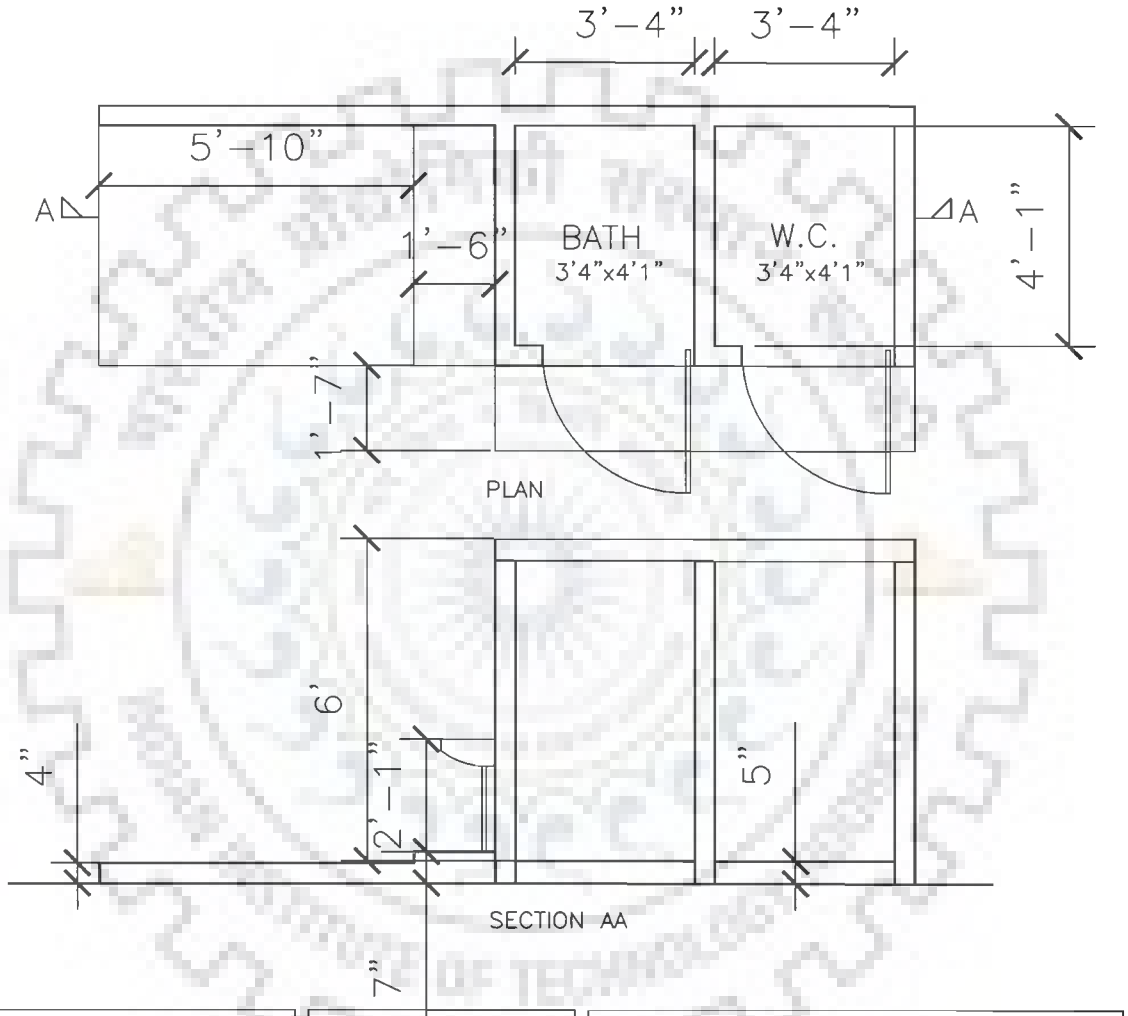
MEASURED DRAWING SURVEY OF TYPICAL RURAL BUILT ENVIRONMENTS	DRAWING TITLE – HAND PUMP & TOILET SPACE	RESPONDENT NO – 2 NAME – RAJ KUMAR VILLAGE – BHANGERI MAHAVATPUR



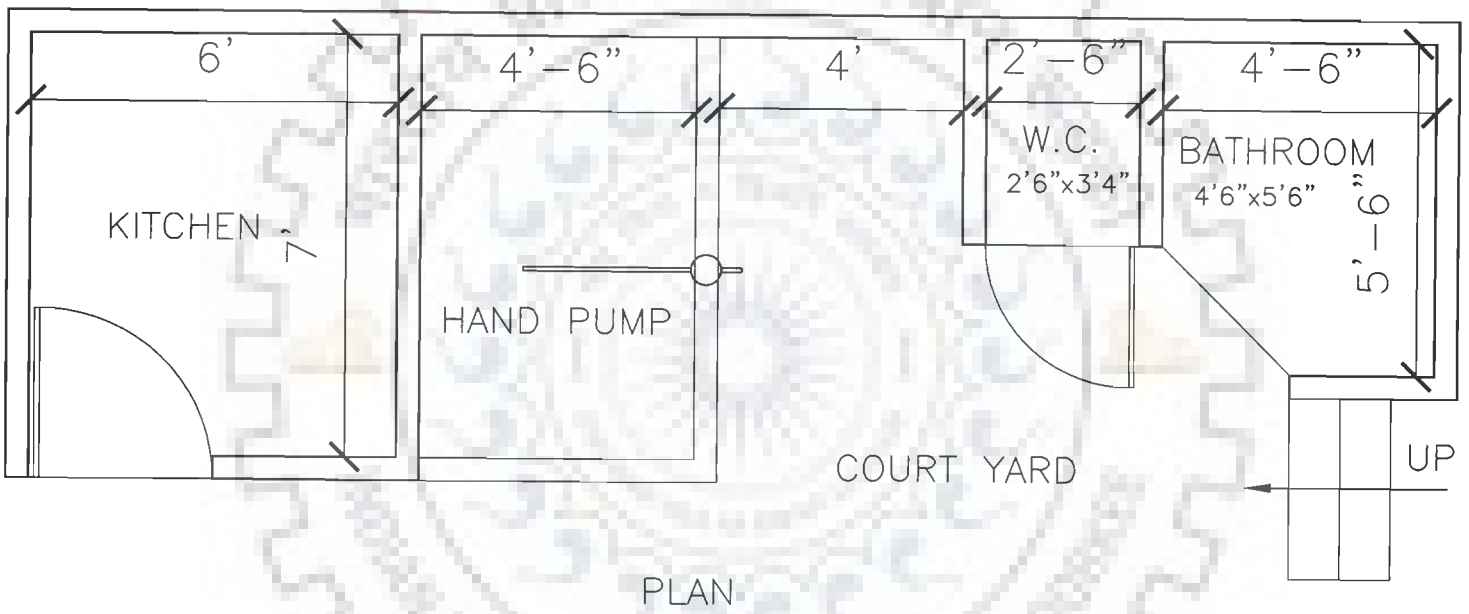
MEASURED DRAWING SURVEY OF TYPICAL RURAL BUILT ENVIRONMENTS	DRAWING TITLE – TOILET SPACE	RESPONDENT NO – 3. NAME – AZAD VILLAGE – BHANGERI MAHAVATPUR



MEASURED DRAWING SURVEY OF TYPICAL RURAL BUILT ENVIRONMENTS	DRAWING TITLE – TYPICAL HAND PUMP	VILLAGE – BHANGERI MAHAVATPUR

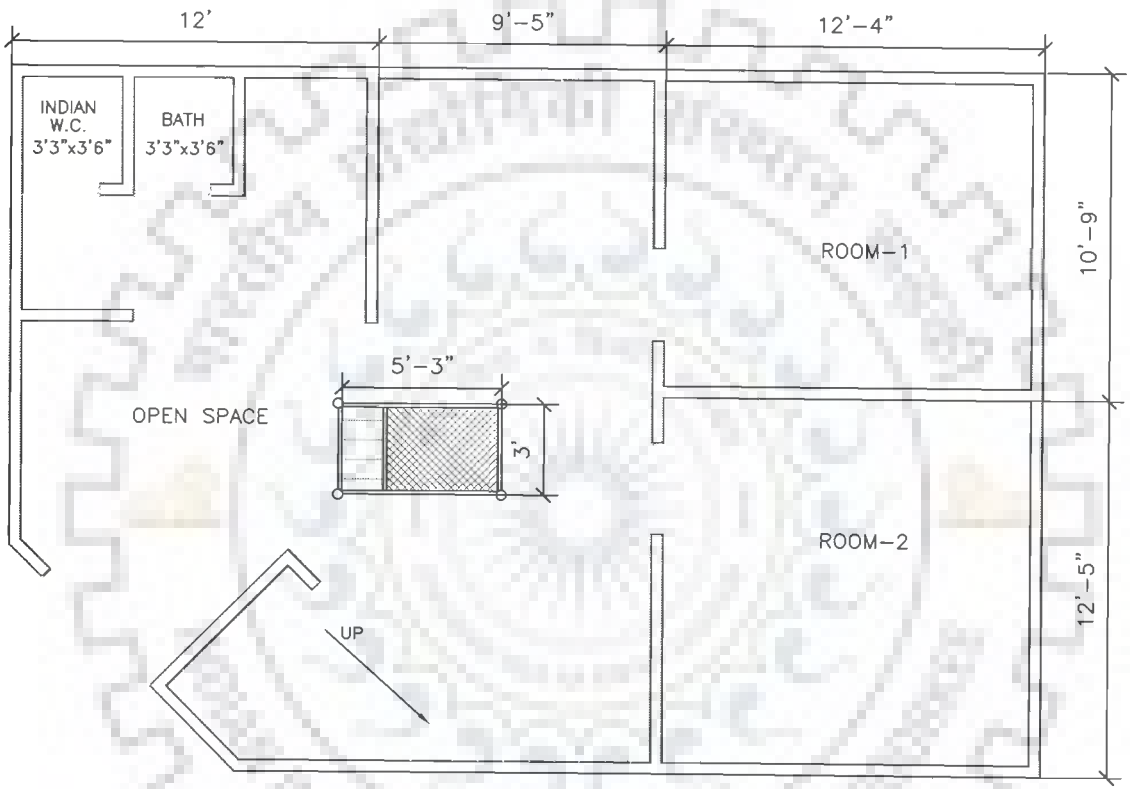


MEASURED DRAWING SURVEY OF TYPICAL RURAL BUILT ENVIRONMENTS	DRAWING TITLE – TOILET SPACE	RESPONDENT NO – 4. NAME – PANKAJ KUMAR VILLAGE – BHANGERI MAHAVATPUR

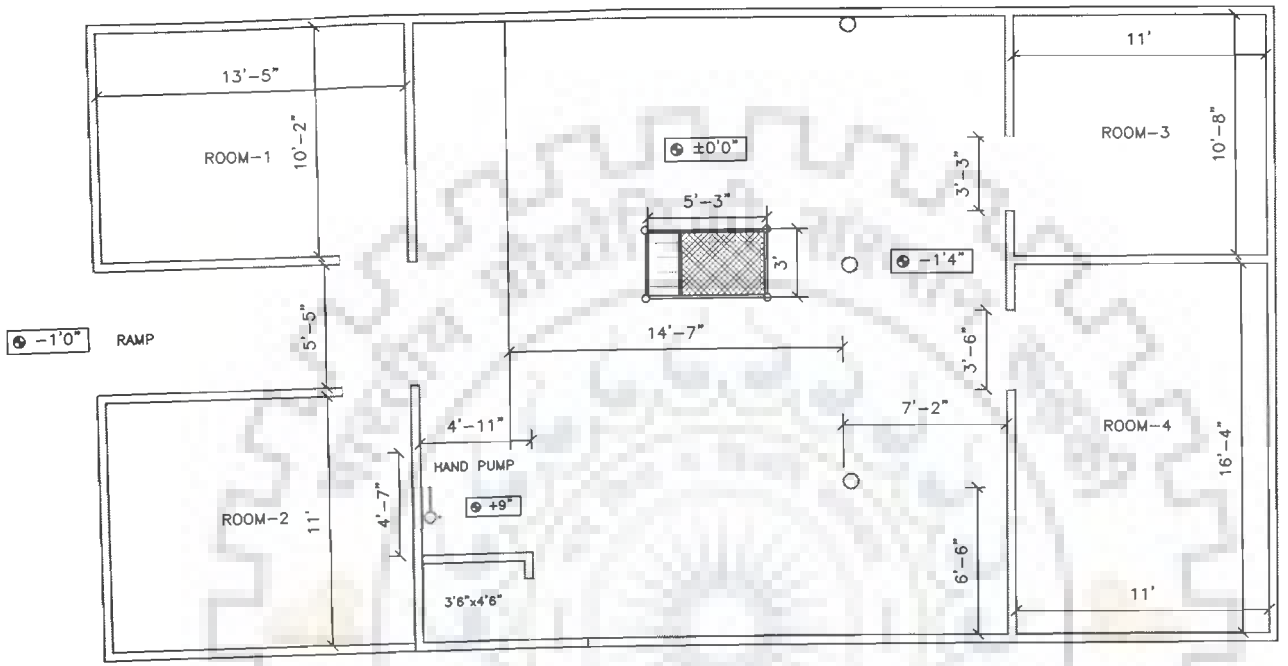


PLAN

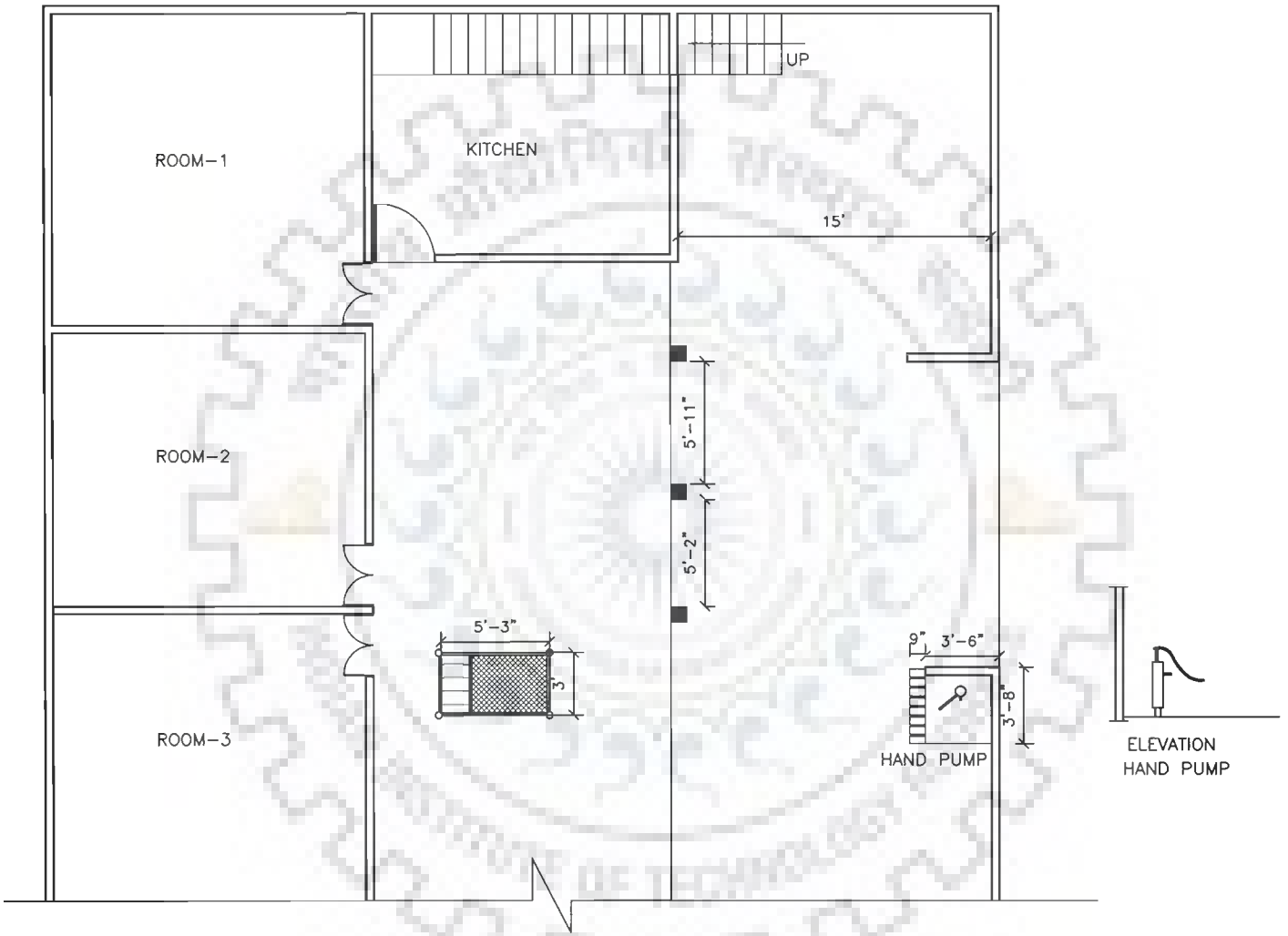
MEASURED DRAWING SURVEY OF TYPICAL RURAL BUILT ENVIRONMENTS	DRAWING TITLE – HAND PUMP & TOILET SACE	RESPONDENT NO – 5. NAME – SANJAY KUMAR VILLAGE – BHANGERI MAHAVATPUR



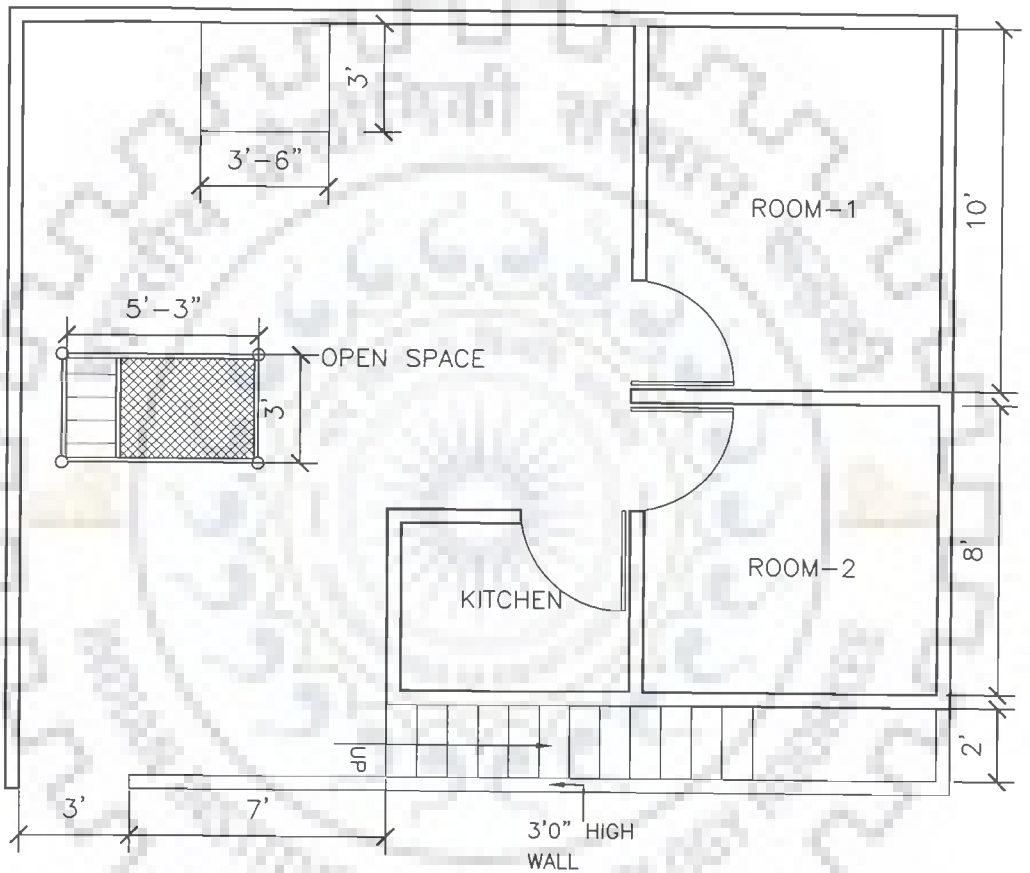
MEASURED DRAWING SURVEY OF TYPICAL RURAL BUILT ENVIRONMENTS	DRAWING TITLE – RESIDENCE	RESPONDENT NO – 17 NAME – MOMIN AHMED VILLAGE – KHANJARPUR



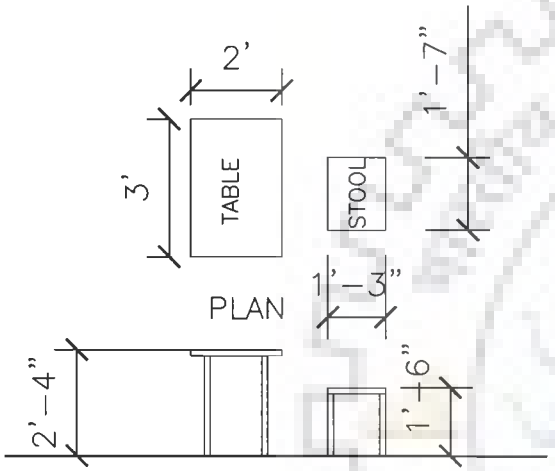
MEASURED DRAWING SURVEY OF TYPICAL RURAL BUILT ENVIRONMENTS	DRAWING TITLE – RESIDENCE	RESPONDENT NO – 18 NAME – SATTU VILLAGE – BHANGERI MAHAVATPUR



MEASURED DRAWING SURVEY OF TYPICAL RURAL BUILT ENVIRONMENTS	DRAWING TITLE – RESIDENCE	RESPONDENT NO – 23 NAME – PRADIP KUMAR VILLAGE – BHANGERI MAHAVATPUR

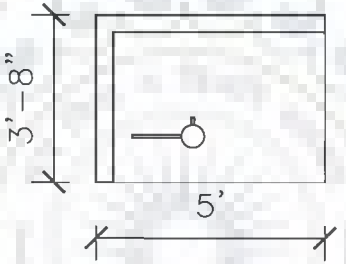


MEASURED DRAWING SURVEY OF TYPICAL RURAL BUILT ENVIRONMENTS	DRAWING TITLE – RESIDENCE	RESPONDENT NO – 24 NAME – SONIA VILLAGE – BHANGERI MAHAVATPUR

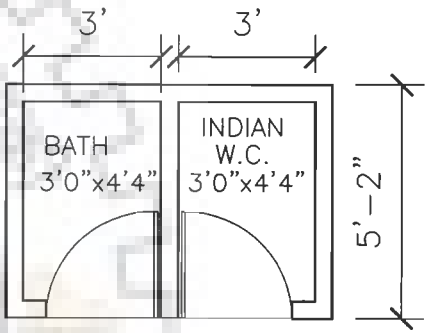


ELEVATION

ARRANGEMENT FOR TAILORING



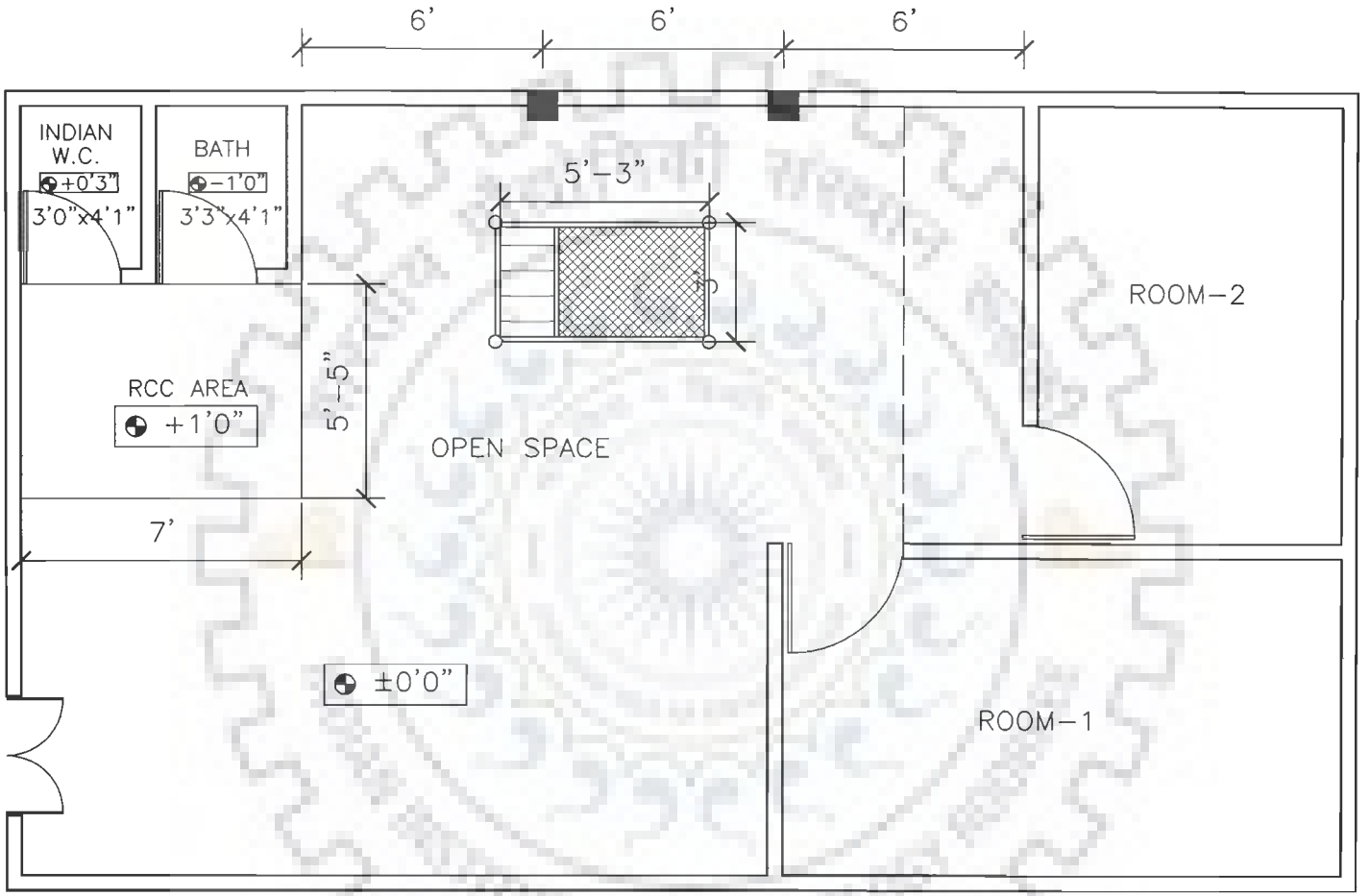
HAND PUMP SPACE



PLAN OF TOILET

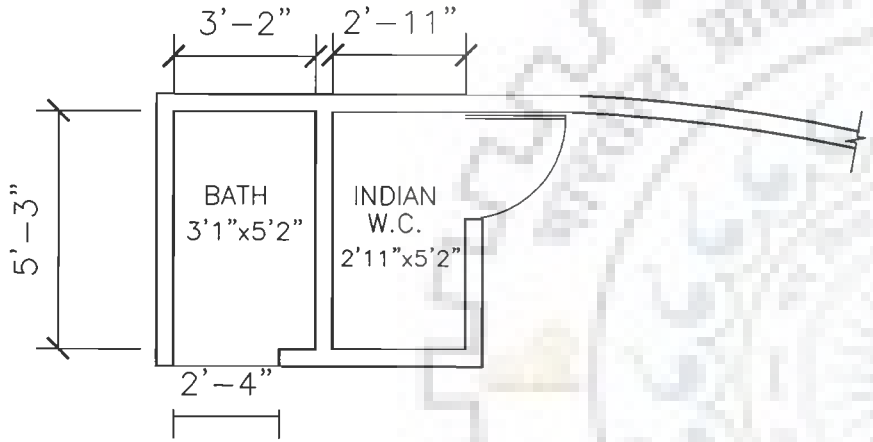
MEASURED DRAWING SURVEY OF TYPICAL RURAL BUILT ENVIRONMENTS	DRAWING TITLE – TOILET & HAND PUMP SPACE

RESPONDENT NO –	25
NAME	– SANDEEP
VILLAGE	– BHANGERI MAHAVATPUR

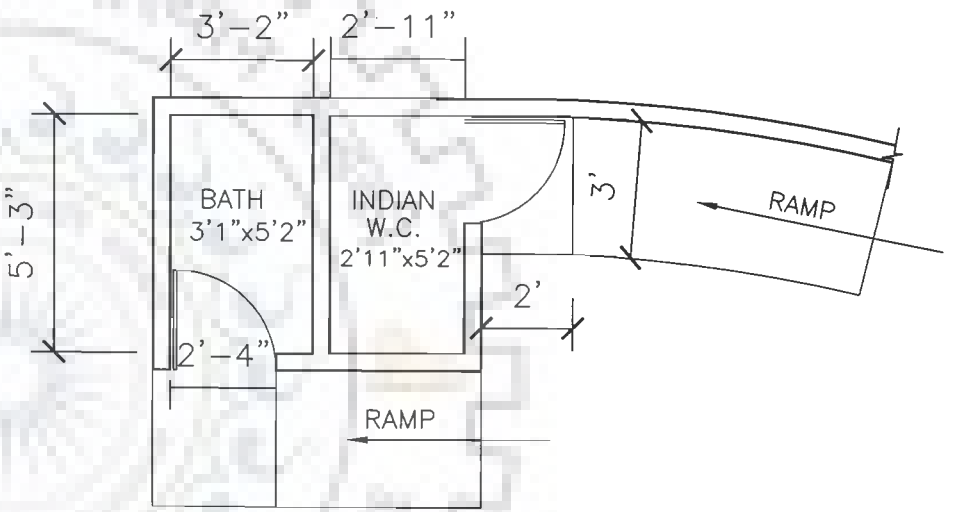


MEASURED DRAWING SURVEY OF TYPICAL RURAL BUILT ENVIRONMENTS	DRAWING TITLE – RESIDENCE	RESPONDENT NO – 34 NAME – SHAHZADI VILLAGE – BHANGERI MAHAVATPUR

38. ISRAR

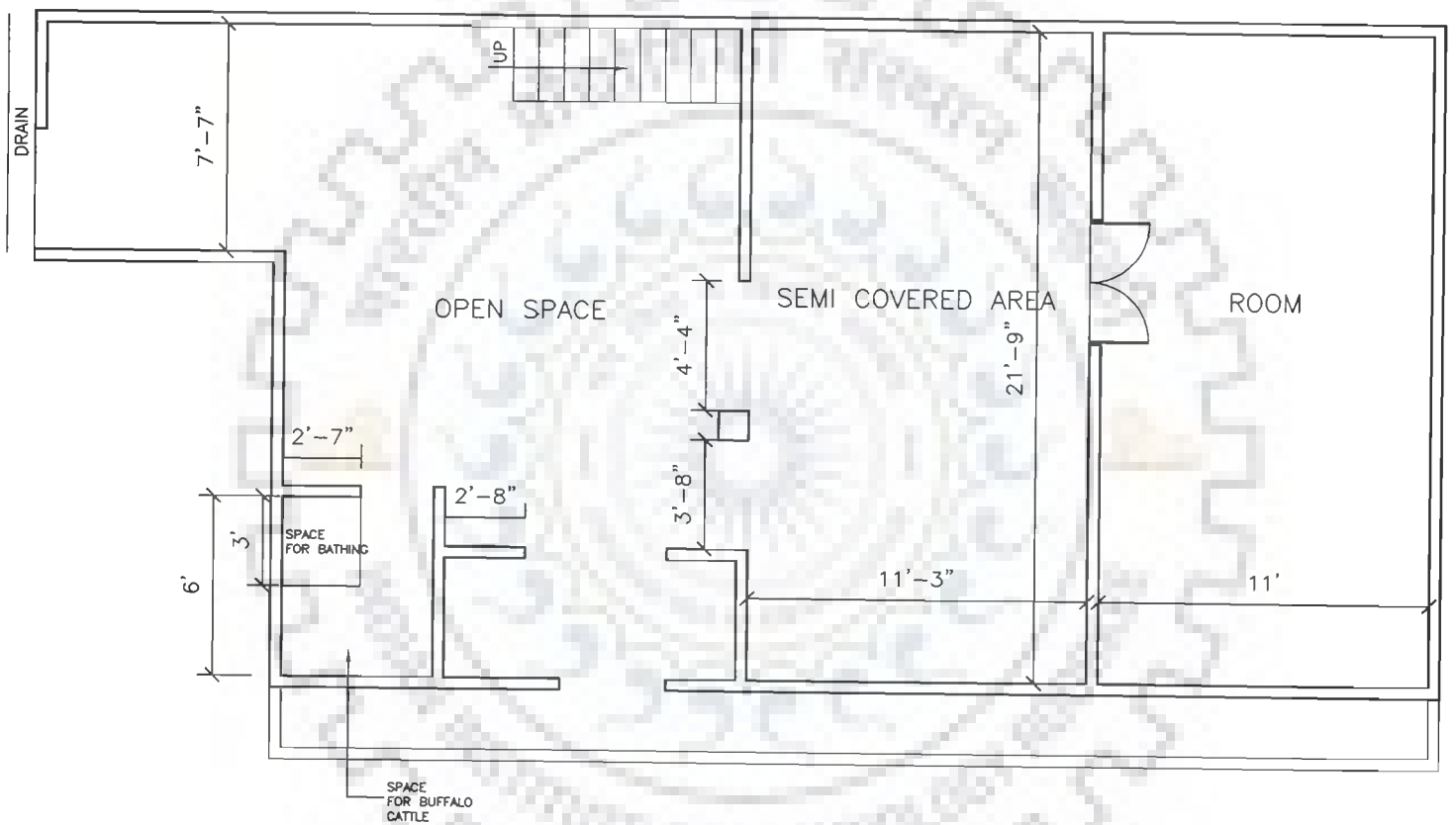


PLAN OF TOILET

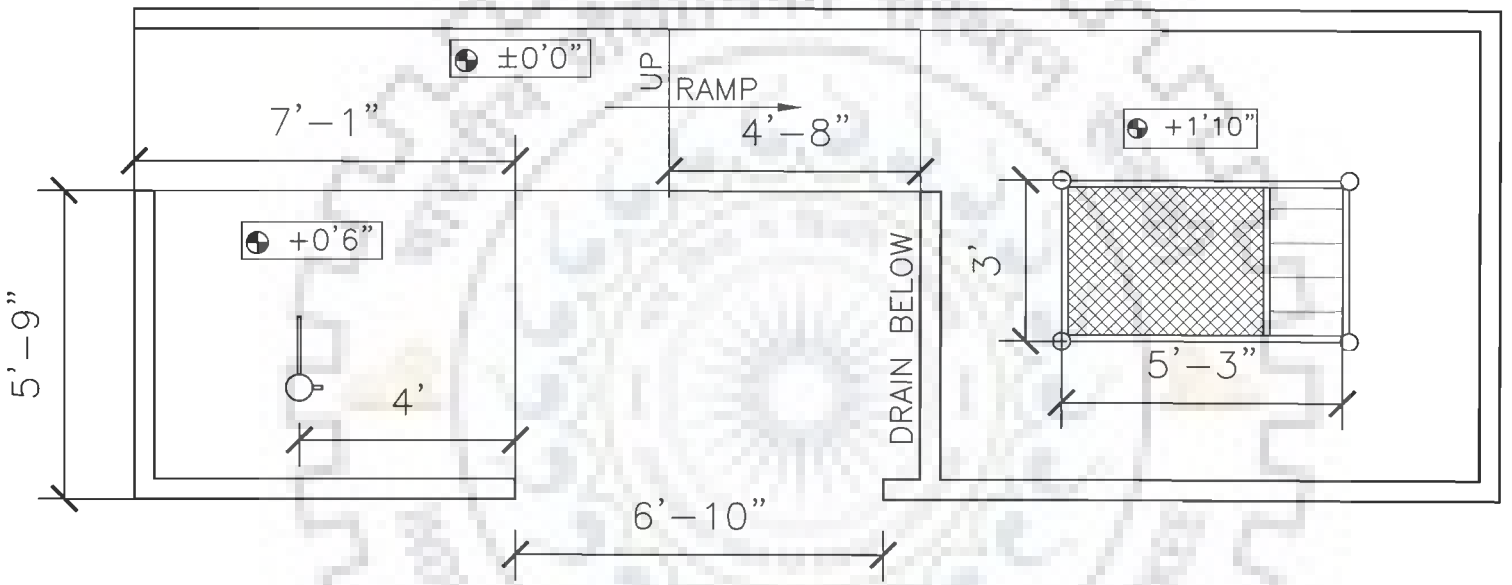


PLAN OF TOILET ALT-1

MEASURED DRAWING SURVEY OF TYPICAL RURAL BUILT ENVIRONMENTS	DRAWING TITLE – TOILET SPACE	RESPONDENT NO – 38 NAME – ISRAR VILLAGE – BHANGERI MAHAVATPUR



MEASURED DRAWING SURVEY OF TYPICAL RURAL BUILT ENVIRONMENTS	DRAWING TITLE – RESIDENCE (MUD HOUSE)	RESPONDENT NO – 39 NAME – FARHAT VILLAGE – BHANGERI MAHAVATPUR



MEASURED DRAWING SURVEY OF TYPICAL RURAL BUILT ENVIRONMENTS	DRAWING TITLE – HAND PUMP SPACE	RESPONDENT NO – 40 NAME – MUJAMEEL AHMED VILLAGE – BHANGERI MAHAVATPUR

APPENDIX IV

RESEARCH PUBLICATIONS BY THE CANDIDATE

Research Paper(s) Published in International Refereed Journal(s)

1. Raheja Gaurav, Kulkarni, S.Y., Handa, S C (2007),**Enablement by Universal Design**, A BI Annual International Journal of Architecture, Conservation and Urban Studies, BITS Ranchi, Vol.2, No.2 pp 31 – 37..

Research Chapter(s) Published in Book(s)

1. Raheja Gaurav, Kulkarni, S.Y. (2005), **Design Approach for Rehabilitation of Persons with Disabilities:** A Compendium on disability published by PSSCIVE (NCERT), Bhopal.

2. Raheja Gaurav, Kulkarni, S.Y. (2005), **Barrier Free Environment : The Pathway to Accessibility**, An Orientation Guide for Promotion of Vocational Education & Training Among Persons with Disabilities, PSSCIVE (NCERT), Bhopal, Pp 82 – 91.

3. Raheja, Gaurav,(2003), **Design Criteria for Built Environment**, Creating Suitable Environment for the Disabled, QIP Centre, IIT Roorkee, Pp 117-123.

4. Raheja, Gaurav,(2003), **Accessibility Issues in Built Environment**, Creating Suitable Environment for the Disabled, QIP Centre, IIT Roorkee, Pp 163-171.

Research Paper(s) Published in National / International Conference(s)

1. Raheja Gaurav (2008), **Accessible Environments Through Universal Design,** National Seminar on Universal Accessibility for Disabled Persons at Department of Architecture, Jadavpur University, Jadavpur. India.

2. Raheja Gaurav (2008), **Understanding Accessibility in the Rural Context,** A Holistic Approach to Create Barrier Free Environments, Ministry of Social Justice & Empowerments and School of Planning and Architecture, New Delhi at Vigyan Bhawan, New Delhi.

3. Raheja Gaurav (2008), **Curriculum Development with Universal Design,** A Holistic Approach to Create Barrier Free Environments, Ministry of Social Justice & Empowerments and School of Planning and Architecture at Vigyan Bhawan, New Delhi.

4. Raheja Gaurav, Handa, S C (2006),Universal Design Approach for mobility in Rural Built Environments, Mobility for All, First National Conference on Accessible transportation, New Delhi

5. Raheja Gaurav, Kulkarni, S.Y., Handa, S.C.,(2005), **Enabling Environments for the Mobility Impaired in Rural Areas**, International Ergonomics Conference on " Humanizing Work and Work Environment , HWWE 2005, organized by IIT Guwahati , Pp 121.

6. Raheja Gaurav, Kulkarni, S.Y.,(2004) **Accessible Environments Through Universal Design,** National Seminar on Universal Accessibility for Disabled Persons at CIRT Pune, Maharashtra.

7. Raheja, Gaurav ,(2004), **Norms, Guidelines and Standards for Barrier Free Environment**, National Seminar on Barrier Free Environment for the Persons with Disabilities and the Elderly, Organised by Ministry of Social Justice and Empowerment , collaboration with IIT Kharagpur, Pp 33-38.

8. Raheja, Gaurav, (2002), **Barriers to Employment Opportunities for the Disabled**, National Conference on Education towards greater employability for Persons with Disability at Ist National Abilympics, New Delhi.

9. Raheja, Gaurav, Kulkarni S.Y, (2002), **Barrier Free Technical Education : The Need Beyond Ramps**, National Seminar on Challenges in Vocational & Technical Education to Persons with Disabilities, at SLIET, Longowal , Punjab, Pp 76-79.

10. Raheja Gaurav, Kulkarni S.Y., (2002), **User Friendly Cities – A future to realize**, National Conference on Planning of Cities of Uttaranchal in relation to Vernacular Architecture, Dept. of Architecture & Planning, IIT Roorkee, Pp 25-30.