Housing in Urban India

By

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for the degree of

Doctor of Philosophy

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Summary of the Thesis

The aim of the study is to look at an integrated approach to sustainability of urban shelter settlements in India in various socio-economic groups in relation to how they respond to global pressures and local needs. Within a more global framework, recommendations made in this study can be applicable to other developing countries facing similar short-term and long-term development problems.

A literature review of present the shelter situation with respect to social, economic, environmental, political and technogical aspects in terms of local and global influences and impacts provides the background data and focus to a series of case studies. Six case studies of urban housing settlements were conducted in two stages- A and B. The A and B category case studies are based on questionnaire and interview surveys across a range of socio-economic groups, identified in the literature review, namely, the economically weaker sections and the low, middle and high-income group households. Respondents' inputs from the surveys on various aspects and shelter issues have contributed to a better understanding of the user-shelter relationship and needs at the local level.

The study indicates that shelter in urban India is needed to sustain immediate social needs and economic activities. Shelter provision is prioritised by the public sector but issues like user needs, shelter quality and negative impacts on the environment are not. At present government bodies are unable to address quantitative and qualitative aspects of shelter, manifested in the informal sprawling squatter settlements, which provide shelter to the economically weaker sections and the low-income groups. These groups use little in terms of energy, and they recycle waste. In that respect these settlements support sustainable principles, to an extent by default due to financial constraints, but their quality of life is poor. The more formal middle-income and high-income housing are more resource and energy intensive, dependent on mechanical systems and have minimum passive design facilities, but have a better quality of life. This suggests that, for individuals, quality of life is important but concern for environment and awareness about environmental issues is low. Also present technology and building material options adopted are energy intensive suggesting a low concern for resource and energy efficiency among various stakeholders. This suggests that shelter is not based on integrated best practice approaches demonstrated in various successful projects such as the low-income group housing in Kerela case study. The following are recommended as a way forward: awareness programs catering for all, a top-down bottom-up approach, future proof house design (designing for upgrading and flexibility), and use of efficient building materials with durable and affordable characteristics. It is also recommended that mixed land-use planning should be carried out, with access to employment opportunities, services etc. taken into consideration when deciding on the location of housing settlements.

Dedicated to my Mother and Father

Acknowledgements

I would like to thank the Almighty Father for giving me the opportunity to carry out this research and for constantly guiding me through it.

I would like to express my gratitude to the people who have made this study possible.

I would like to give special thanks to, my supervisor Phil Jones for his encouragement, constant guidance and steering me along the right path. The staff of the architecture department at WSA, Cardiff University, especially Katrina for all her help and support.

In India, the case study respondents in Chennai, Navi Mumbai and New Delhi, all the public sector officials who shared their experiences, views and provided valuable inputs to this research. Mr Tripathi for his help and guidance in Navi Mumbai. I would also like to thank all the staff from my father's office for their comments and secretarial work with printing and photocopying the questionnaires. Mrs Sarla Gopalan for her valuable comments. My friends and colleagues in Wales, companions who have completed their studies and gone back to their respective countries, for supporting me and for all the memorable moments we all had, adding fun and excitement to the research years.

Lastly, I am indebted to my parents without whose love, support, encouragement and blessings, I could not have accomplished this study. I would also like to especially thank my husband Aroop, James, Jasmine, Conrad, Agatha, Paz and Leon and rest of my family and friends for their love and support.

The views, opinions and interpretations expressed in this book, with all the errors are mine and none of those who have assisted in their development necessarily have the same opinion.

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Chapter I
Introduction

" We as a society have once in a generation opportunity to built sustainable communities. We must make the make the right choices to provide the homes and jobs that people need without jeopardising their quality of life, now and in the future"

RSPB, Sustainable Communities: Creating the Right Environment

This chapter begins with an introduction to present condition and concerns of urban shelter in India. It then introduces the aim and the objectives of the study along with the structure and a brief introduction to the methodology

1.1 Background study on urbanisation and urban shelter:

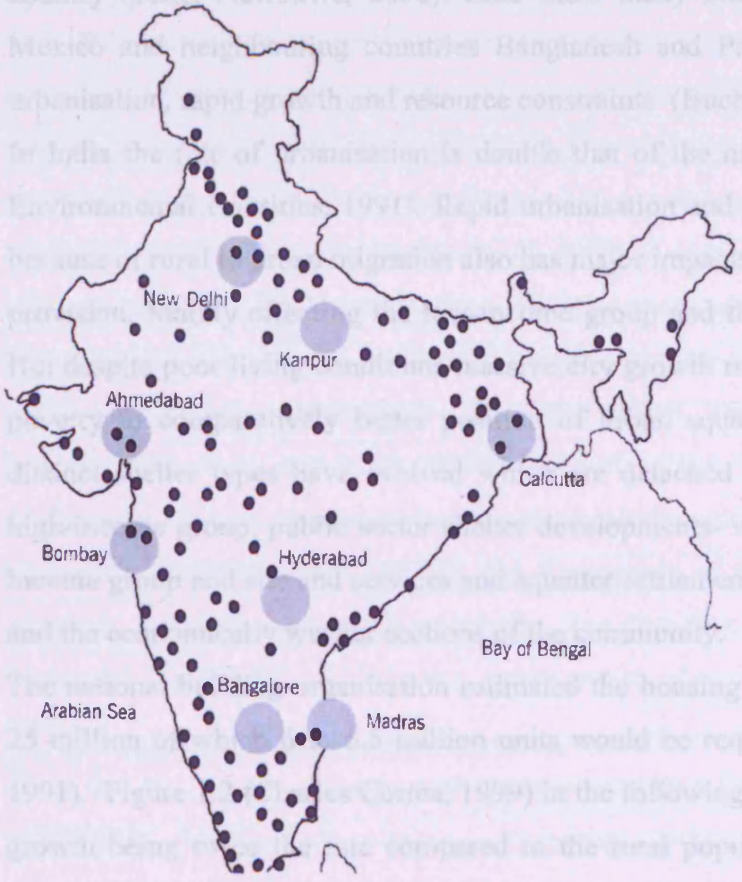


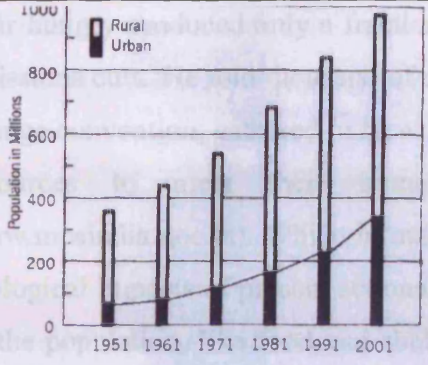
Figure 1.1: Map of India showing all the capital cities and the smaller dots showing the urban centres

In the last century India has grown not only with its industry, education, communication and economy but also in terms of its population, mostly the urban population. Figure 1.1

(Charles Correa, 1999) shows the main urban centres of India. The United Nations estimate that about 177 million people will live in cites alone representing almost half the projected urban population of India. The urban population of India as per 1991 census was 217 million accounting for 25.7% of the country's population living in urban settlements one form or another (HUDCO, 1999). According to the United Nations Population Fund representative Mr Michael Vlassoff, since 11 July 2000, India's population has grown at 15.6%, whereas the Chinese population has increased at 11.1%. In the past few years the average of the Indian population growth was 1.64% while the rest of the world was at 1.33% and the average Indian population density stood at 308 persons per square kilometre while for the rest of the world it was 45 persons per square kilometre. The impacts of this land ratio were adverse effects on water availability, agriculture and forest cover in the country (TERI Newswire, 2000). Like India many other developing countries such as Mexico and neighbouring countries Bangladesh and Pakistan will face the problem of urbanisation, rapid growth and resource constraints (Buch.N.M, 1991).

In India the rate of urbanisation is double that of the national population growth (India: Environmental Priorities, 1991). Rapid urbanisation and urban population growth, mainly because of rural to urban migration also has major impacts on the shelter quality and shelter provision. Mainly affecting the low-income group and the economically weaker sections. But despite poor living conditions massive city growth represents the transference of rural poverty to comparatively better position of urban squatters. In most urban areas three distinct shelter types have evolved which are detached private houses- that cater to the high-income group, public sector shelter developments- which cater mainly to the middle-income group and site and services and squatter settlements- which cater to the low-income and the economically weaker sections of the community.

The national building organisation estimated the housing shortage in India during 1987 as 25 million of which 6 to 6.5 million units would be required in urban areas (Buch.N.M, 1991). Figure 1.2 (Charles Correa, 1999) in the following page shows the urban population growth being twice the rate compared to the rural population growth between the years 1951 to 2001.



Urban population is growing twice as fast as the rural population

Figure 1.2

In the past people constructed their own houses with mutual help or using local masons and making use of locally available materials and hence shelter requirements were simple. India's rich architecture could be seen in the self-built vernacular architecture but today the growth of population and poverty can be seen in the self-built squatter settlements of urban centres where conditions are deplorable. The environments of these settlements are in extremely poor uninhabitable conditions. The condition of public sector housing is not satisfactory either, since in the urgency to replicate numbers the quality and user needs are often overlooked. (K.Thomas Poulose, 1988). According to Environment Systems Branch, Development Alternatives, settlement planning in most regions of India needs to be given maximum priority particularly in areas where high rates of urbanisation and industrialisation is occurring (India: Environmental Priorities, 1991). According to Mabogunje, despite the inconclusive nature of the evidence most sources agree on the correlation between quality of life and the quality of the physical environment. Hence greenery, vegetation, clean air and water, low densities etc are considered beneficial for biological as well and psychological development of an individual (Mabogunje A.L. et al, 1978).

Over the last decade, environment management has become an integral aspect of any sustainable development planning including shelter development; the concept of sustainability combines the objectives of economic development, social equity and environmental soundness. However in most developing countries long-term sustainability goals conflict with the short-term needs for economic development and poverty alleviation. The former Prime Minister of India Mr Atal Behari Vajpayee, stated in the opening ministerial talk at a U.N. climate conference that developing countries struggling to feed

their hungry produced only a fraction of green house gases and could not afford the extra emissions cuts. He told thousand of delegates from 185 member states of the U.N. climate change convention, gathered in New Delhi, that developing countries did not have adequate resources to meet their human needs (Shri Atal Bihari Vajpayee, 2002, www.meaindia.noc.in). Whilst in many parts of the world people are addressing long-term ecological impacts of present actions, India has to first deal with sustaining the basic needs of the population, like food and shelter, along with economic development that is able to provide immediate results. A large percentage of the population in India is still struggling to meet their basic needs and as such most do not care about long-term needs and impacts. Therefore priority is often given to short term economic development over a more long-term approach to sustainable development. Since independence, the main objective of planning has been economic development of the country but these schemes and policies have not yet achieved much improvement to the living environments of the urban poor (Aromar Revi, 1990). According to a survey conducted by International Council for Scientific Unions which also covered India, most of the third world countries government cannot afford to provide shelter for all its population as a result of which most shelter are self provided. Self-provision however starts in a poor way and gradually improves with economic growth and management. Therefore governments should support people's willingness to help themselves, which would help promote a gradual improvement in people quality of life (Mabogunje A.L. et al, 1978). Z. N. Ahmed in conference paper "Temperature Standards for the Tropics" states that due to rapid population growth in Bangladesh "economic situation dictates most of the planning decisions at both the Government and private sectors" and from " the architects point of view maximum space utilisation is the priority and climatic considerations receive very little attention" (Ahmed.Z.N, 1995).

Although urgency demands that more attention be given to economic developmental needs, in the midst of consumption patterns leading to pollution, degradation, depletion of natural resources and energy scarcities, efficient long-term planning cannot be undermined (India: Environmental Priorities, 1991).

Shelter influences the environment mainly through consumption of natural resources, adding physical objects to the environment and acting as an intermediary between man and nature. Shelter design is determined by social norms and practices and environmental factors such as physiology and climate. Therefore acting as an intermediary between man

and nature in a physical sense and in a social sense between man and society. Although shelter represents among many things an individual refuge, status, identity, social and economic conditions, creating shelter also depletes natural resources and its metabolic processes pollute the air, water and land. Such metabolic process affects not only the local immediate environments but also global environment through resource consumption and waste in local and distant areas. However it is not clear what levels of metabolic processes are likely to endanger the environment and living creatures, it is certain that there is a limit to resources and to pollution (Mabogunje A.L. et al, 1978).

In India, as elsewhere in the world, buildings play a significant role in the global energy balance (Teri, 2000). The impacts of population growth and urbanisation are felt in the housing and the construction sector, where housing sectors are unable to cope in providing neither adequate shelter nor basic service. Similarly the impacts of the actions of the construction sector are also felt socially and the ecologically, creating an unsustainable development (about 25% of the total energy demands of the nation are due to manufacturing materials for the building, while another 30% go into the running needs of the building, (Teri, 2000). In India construction activity accounts for more than 50% of the national outlays and building construction costs have registered increase in prices year after year at scales much higher than inflation (at around 15% annually even when inflation is in single digit). Today, builders are turning out a product that only the middle and the higher income groups can afford, forcing half of the population of most cities to live on the pavements or in squatter settlements (HUDCO, 1997). At present most builders use brick and cement for construction, which use large quantities of fuel in production, which has lead to the mass destruction of the rich natural resource base of the country (www.teriin.org).

Shortage of funding and resources in a densely populated city has in many ways also lead to the growth of urban slums where the basic services such as safe drinking water supply and sanitation is inadequate. "The disagreeable effects of rampant urbanisation are often at their worst in hot climates of some developing countries, which unfortunately is where sprawling cities are growing more swiftly, often in a haphazard way without proper regard for crucial climatologically considerations" (WCP/WMO Publication).

Due to the high cost and unavailability of affordable materials the population of the squatter settlements depend on the re-use and recycling of materials from demolition sites resulting in a thriving recycling system. In the process saving building waste from going to land fill

sites. Figure1.3 (Charles Correa, 1999) below shows a congested and rundown urban slum by the railway tracks of Mumbai. Most urban centres have a similar scene of urban slums providing shelter to millions.

Figure 1.3

All over the world "There are nearly 100 million houseless families in the world today " (K.Thomas Poulose, 1988). In India as well, majority of the population do not have access to basic shelter, particularly the low-income and economically weaker groups. Some innovative attempts have been made to improve access and shelter conditions, such as providing site and services units and use of alternative technology and recycled materials like fly ash by housing institutes like Hudco and Cidco, but without much success. The impacts of these attempts has been limited to the institutes and not reached the masses due to lack of knowledge and information on appropriate technology construction, limited adaptability to local needs, lack of trained personnel and institutions providing support (Aromar Revi, 1990).

Studies conducted by National buildings organisation of the ministry of technology transfer, experimentation, development and dissemination of housing statistics suggests around 2 million new units are needed each year for the increase in population and that the gap between the two is widening (NBO, 1988). The National Buildings Organisation has estimated the shortfall of around 18 million to 23 million dwelling units. The percentage increase in housing stock which was 23% in 1981 is still lower than the percentage increase in population which is 25%, Some 50% of the urban households and 47% of the rural households live in one room housing units, out of which 12% to 15% are unfit for human habitation (K. Thomas Poulose, 1988). Shelter policies indicate that formal institution like Delhi Development Authority and CIDCO (City and Industrial Development Corporation Limited) have been developed in order to tackle the shelter problems. However, the public sectors have not been able to successfully address this growing shortage nor the poor

quantity of shelter in India. These institutes execute mass production with minimal or no user participation in planning and therefore are not based user requirements. In order to maintain man-shelter-environment relationship at a safe level requires not only individual and societal responsibility but also government responsibility and action through effective policies and rules of behaviour (Mabogunje A.L. et al, 1978).

1.2 Summary of the background study:

Urbanisation and rapid population growth are affecting adequacy and access to basic shelter by a large section of the urban population. Since supply is not keeping pace with the growing demands. In order to address this problem public sector housing bodies have undertaken mass housing construction but funds and resource constraints quality is often compromised. As mentioned before large sections are compelled to live in squatter, which are often unsanitary. Hence in India the present problems of housing does not confine itself to quantity, the quality of housing need to be simultaneously addressed. When the rest of the world in struggling to deal with the issues like global warming and ozone depletion, in India more fundamental issues like poverty, unemployment, hunger, and shelter inadequacy need urgent attention. On one side India faces problems of poverty, food, unemployment, housing shortage along with financial constraints, which, call for short-term economic actions, and on the other, the need for implementation of long-term sustainable development plans and policies. Therefore in order to find a balance between current issues of poverty and climate change, shelter issues need to be integrated with of the overall development of the country through proper evaluation of present action and future impacts with particular regard for the poor. For development to be sustainable it must integrate all aspects, which are social, economical, environmental, political and technological. This study will therefore look into these aspects of shelter in the following chapters based on literature review data and the finding of the 6 case study site, questionnaire and interview surveys.

1.3 Initial Hypotheses: The set of initial hypotheses stated below have been developed for the purpose of guiding the review and study of social, environmental, economic, political and technological aspects of urban housing in the literature review and the stage A pilot case studies. This set of initial hypotheses are background study findings of this chapter and are as follows:

Social: Urban housing conditions do not satisfy the general housing needs of the dweller.

Economical: Basic housing in urban area remains inaccessible to the masses due to high shelter costs and budget constraints of the households and public sectors shelter providers.

Environmental: General comfort conditions are unsatisfactory in urban housing.

Political: Housing policies and programs are based on public body understanding of user needs and not on real user inputs.

Technological: Despite efficient alternative building material options present choices adopted are not cost, resource and energy efficient.

Key Questions: In order to guide the study some key questions have been developed which will be addressed in the case studies and the literature review as well and are as follows:

1. How are the global actions like treaties to reduce carbon emissions, energy efficient shelter and sustainable development affecting the local developments and vice-versa?
2. What are the various factors influencing urban shelter and shelter types?
3. What are the major constraints urban shelter developments are facing today in terms of basic shelter provision?
4. What are the technology options available for a sustainable shelter development?
5. Should priority be given to short-term local needs or long-term global implications?

1.4 Aim of the Present Work:

As already discussed in this chapter, for shelter to be sustainable it must not only be resource and energy efficient, it must also sustain the needs of an individual. In order to ensure this all aspects from micro level basic user requirements, domestic efficiency requirements, funds and materials used, to the macro-level impacts on the environment to police and strategies that guide and deliver them, need to co-ordinate and understand each other. A quote by Mahatma Gandhi given below describes in simple words how the solution to macro problem lies in micro areas.

"Live simply that others may Simply Live"

Mohandas Gandhi (1869 – 1948)

The aim of this study: is to study sustainability in urban shelter settlements in relation to how they respond to global pressures and local needs. Hence the study will proceed by

looking at how social, economical, environmental, technological and political factors affect present urban shelter within the user subjective context and the impacts of shelter processes on the environment. Investigations intend to determine present shelter needs, impacts, drawbacks and options available in order to make recommendations towards a process, which considers the balance of short-term housing needs and the long-term sustainable impacts. Recommendations will address restoring existing systems, re-using & recycling materials and promoting resource efficiency by integrating social needs, environmental concerns, economic growth & viability, political and technological priorities.

1.5 Objectives of the Present Work: In order to achieve the aim of this investigation the following objectives have been set:

i) Literature Review: To review the literature on the impacts of social, economic, environmental, political and technological aspects on shelter in relation to past and present developments, future indications along with a review on local and global contributions in these areas. The review will help in providing the knowledge to make decisions about which areas will be studied in the case studies. The literature review was carried out to access past and present patterns of shelter development and future indications. In addition to providing a background for this study the literature review will also contribute towards the development of a structure and methodology for carrying out the stage, 'A & B case studies'. The data concerning the user needs of shelter have been reviewed within the context of five areas as follows: i. In the social context user needs/preferences and satisfaction levels, ii. In the economic context the cost and affordability of shelter, iii. In environmental context comfort and energy use, iv. In political context user awareness/contribution to macro aspects of shelter mainly programs and schemes, v. In the technological context what building materials are adopted and why, will be studied.

ii) Case studies: To select and carry out a series of case studies. The case studies were conducted i. to find out the purpose of concepts and planning principles, building materials used, structural systems used to guide the design of shelter ii. the questionnaire and interview surveys were conducted in order to determine the subjective nature of shelter such as preferences, trends, comfort and other social, cultural, physical and psychological needs of the individual, which also guide the design of shelter. There the main aim of the case studies conducted were to gain better understanding of the two aspects of a balanced design 'how and how much". This understanding may also help inform designers on how to

address user requirements using sound and effective measures with consideration for the social, economic and environmental implication of shelter on individual, local, national and global issues.

The case studies have been divided to two stages, stage A and stage B and each stage consisting of three case studies, which are described below. The case studies are located in urban settings and in both stages site surveys were carried out, which include questionnaire surveys and interviews and site surveys.

- **Stage A case studies** These case studies were carried out to investigate what patterns of sustainable shelter development in urban areas emerge and who and what will be the main contributors. Additional information gathered contributed to the understanding of the user-shelter relationship. Finally this set of case study findings act as a base for further research conducted in stage b case studies. The three stage A case studies are summarised below:
    a) **Stage A Case Study 1** A middle income group (MIG) housing development in New Delhi and implemented by Delhi Development Authority (DDA)
    b) **Stage A Case Study 2** A low income group (LIG) housing development in Kerela implemented by Costford
    c) **Stage A Case Study 3** A low income group (LIG) and lower middle income group (MIG) housing development in New Mumbai implemented by City and Industrial Development Corporation Limited (CIDCO)

The stage A case studies were also used to pilot the investigations and in particular they were focussed on finding out what user needs are, how and at what costs these needs are satisfied and barriers within the context of social, economic, environmental, political and technological shelter aspects.

- **Stage B case studies** These case studies were carried out in order to investigate further the sustainability of urban shelter development within the context of sustaining user needs and sustaining the environment. They investigate the areas where changes can be effectively adopted in order to contribute towards a more sustainable urban shelter development within present limitations and without compromising on user needs and preferences. In addition quality of shelter means many different things to different people, the case study investigations will help to find out more on what people commonly associate quality of life with. Their inputs

on various aspects of shelter concerning them will contribute to a better understanding of the user-shelter relationship at different levels of the urban community. The three stage B case studies are summarised below:

a) **Stage B Case Study 1** A middle income group (MIG) housing development Basant Enclave in New Delhi implemented by DDA
b) **Stage B Case Study 2** A low income group (LIG) and economically weaker section (EWS) squatter housing development Bhumeeheen Camp in New Delhi
c) **Stage B Case Study 3-** A high income group (HIG) private houses in New Delhi

(Different income levels were selected in order to investigate the co-relation between income levels and shelter types, quality of life, lifestyles adopted in addition to socio-economic grouping, education, and knowledge and awareness levels).

iii) Discussion: The result from the literature review and the finding of the stage A and stage B case studies are discussed in relation to the thesis aims and objectives.

iv) Recommendations: Based on the findings of this study recommendations are made on how and where changes can be adopted by integrating short-term economic and social needs of the government and the urban population keeping in mind the long-term sustainable implications on the environment.

v) Summary of Conclusion: The conclusions address the key questions and discusses the key findings.

1.6 Structure of this study

This study has been categorised into four aspects, which are social, economical, environmental, political and technological. These aspects will be studied on three levels, which are- user level, local context and to an extent global context in order to gauge local needs and environmental concerns of various shelter issues, concerns and implications. While past and present activities will be looked at in the literature review, the case studies will focus mainly on user inputs.

The structure is described in the figure 1.4 in the following page.

Sustainable Aspects	**Individual Concerns Case Studies**	**Local Context Literature review**	**Global Context Lit review**
Social	Will look at shelter satisfaction levels among various income group households.	Will review the social & cultural influences on shelter.	Will review global influences on local shelter.
Economic	Will look at social backgrounds & factors affecting accessibility to shelter.	Will review economic development in relation to shelter provision.	
Environmental	Will look at comfort and energy use in shelter.	Will review the impacts of shelter and shelter processes on the environment and vice versa.	Will look at impacts of local processes on global concerns and vice versa.
Political	Will look at level of user involvement & opinions on the micro and macro aspects of the shelter processes and their implications.	Will review present concerns with respect to shelter schemes & programs developed and implemented.	
Technological	Will look at building materials & building technologies adopted with respect to user requirements.	Will review various conventional building material technologies, alternative options available & their characteristics.	Will look at global influences on the shelter technologies adopted.

Figure 1.4

1.8 Validity and Reliability:

Validity of the research conducted is an important and significant aspect of a study. "Validity indicates the extent to which a measure, indicator or method of data collection reflects the concept of interest. If a measure is considered to be valid, this means that it is thought to measure what it sets out to measure" (Investigations in the built environment, MSc in Architecture; Environmental Design of Building, Welsh School of Architecture). Validity has two parts: external validity and internal validity.

External validity: accesses whether the findings will be representative and whether the results can be generalised to similar circumstances and subjects (Creswell W. John, 1994). A study that lacks external validity cannot be projected to other situations; it is valid only for the sample tested (Wimmer and Dominic 2000:36). In the context of external validity the recommendations made in this study can be made applicable and relevant not only among urban shelter settings but rural settings, as well to other developing countries that are going through similar conditions of economic development and shelter crises and have been discussed more in detail about its applicability in chapter VI.

Reliability refers to the dependability of the data collected or the test or measurement used to collect it (Investigations in the built environment, MSc in Architecture; Environmental Design of Building, Welsh School of Architecture). The primary data collected will be from the random questionnaire surveys conducted along with structured interview conducted among the case study respondents and interviews carried out among executing public sector planners and builders. Secondary data collected in order to support the study will be in the form of written official and other printed data acquired during the case study site surveys. In addition a coding scheme developed by Reuss Ianni (Source: Reuss Ianni, E 1983, Two Cultures of Policing) reproduced in the figure 1.5 in the following page, has been adopted to measure the data collected in the case study interviews. Where validity score is low for instance interview data is from a single informant, a high reliability score is ensured. Hence in the case data from a single informant, the informant chosen is reliable such as one representing an organisation or the community and vice-versa. In the case of household interviews the information gathered is supported with additional data such observation, documentaries etc.

Validity Score	Reliability Score
A) Data gathered through observation with direct participation	1) Informant always reliable
B) Data gathered through observation	2) Informant usually reliable
C) Interview data checked against documentary or other reliable source	3) Reliability of informant unknown
D) Interview data corroborated by one or more additional informants	4) Informant unreliable
E) Interview data from a single informant	

Figure 1.5

1.9 Definitions and Terminologies used in this study:

Given below are basic definitions and information on basic terminologies used in this study-

Shelter or house: Shelter has been described as " protection from danger, bad weather" (Oxford Dictionary). The house has been described as " our first universe, a real cosmos in every sense of the word" (Bachelard Gaston, 1994). According to Mabogunje, "a good human settlement is one where the housing needs of everyone are satisfied without adversely affecting the man-nature relationship or the legitimate interests of other people". Shelter provides mans biological needs such as clean air and water, his physiological needs such as satisfaction, privacy, security etc his social needs such as interaction with other, human developments and cultural activities ((Mabogunje A.L. et al, 1978).

Sustainable development is often defined as "Development that meets the needs of the present without compromising the ability of the future generations to meet their own needs" (Brundtland Report, 1981). "In a narrower sense it also means environmentally responsible development" (Tapati Mukhopadhyay, Shanghai and Mumbai, 2001).

Comfort means a state of physical well-being and comfortable means to have an adequate standard of living free from discomfort (Oxford Dictionary). The purpose of a home is to provide shelter and security from harsh external elements of nature. One of the main functions of a home is also to provide comfort. "Comfortable environment is one in which there is freedom from annoyance and distraction so that working or pleasure tasks can be carried out unrestricted physically or mentally. Ong Lay Boon and Hawke U Dean argue that comfort can influence an individual's visual experience of a place or space. According to them although beauty is commonly thought to refer only to visual experience, many of

the pleasurable experiences related to place are not so much visual as they are thermal. For instance activities like going to the beach, reading a book in the conservatory walking in the park etc are all activities associated with certain thermal characteristic. They argue that it would be difficult to imagine a place and consider it beautiful under less than optimal conditions such as a beach on a cloudy day. According to them beauty is determined by two features one is by sensations enhanced by orderliness in its composition which is the other feature (Ong Lay Boon & Hawke U Dean, 1997).

Passive systems use simple technologies and on-site energy in combination with architectural components while active systems work mechanically using fans and pumps (Basin News, 1999). Passive cooling usually refers to simple cooling techniques that enable the indoor temperatures of the building to be lowered through the use of natural energy sources. The term 'passive' however does not exclude the use of fan when their application might enhance performance. The indoor air temperature caused by the direct and indirect solar energy gain is referred to as the sol-air temperature elevation. Passive design such as layout, natural ventilation, shading devices, thermal resistance and orientation can only minimise the sol-air elevation and choice of materials (not storing too much heat like wood, lightweight concrete, perforated bricks etc) aiming to provide comfort can minimise the demand for energy used to cool the building. The appropriate application of passive designs can bring the average indoor temperature close but usually not below the level of the average outdoor temperature (Givoni Baruch, 1994).

1.10 Outline of Chapters:

1) **Chapter One: Introduction-** This chapter is intended to inform the reader about the context and contents of the study through the background, the aim and objectives, key questions and hypothesis developed, the structure adopted for the study and the contents of the subsequent chapters.
2) **Chapter Two: Methodology-** The methodology chapter describes the method adopted for the study, the tools used to carry out the investigations in the case studies.
3) **Chapter Three: Literature review-** The literature review section is fundamental in providing background information for this study and the contents provide a basis for the purpose of this study. The review starts with a brief introduction and further

goes on to review the social, environmental, economical, political and technological aspects of urban shelter in India within local and global framework in more detail.

4) **Chapter Four: Stage A Case Studies I, II & III**– Chapter four introduces the three stage A case studies, the aim, objectives and structure of the case studies to the reader. Each case study is then introduced and the analysis and results of the study carried out is discussed respectively. This chapter also discusses the results of the study with respect to the hypotheses and the issues raised in the literature review. This chapter further goes on to prepare the reader about the contents and relevance of the stage B case studies.

5) **Chapter Five: Stage B Case Studies I, II and III-** This chapter describes the aim, objectives and structure of the case studies. The individual chapters are then discussed in detail, which include the analysis and the results of the individual studies with respect to the hypotheses. The previous chapters will have prepared the reader to proceed to the conclusion of the study, which is discussed in chapter six of this study.

6) **Chapter Six: Discussion, Recommendations and Conclusions-** This chapter starts with discussion on the literature review and case study priority findings within various aspects, followed by a recommended model which can help identify short and long-term local and global priorities and possible solutions. This study addresses the key questions developed in order to guide this study, followed by a summary of conclusions, which state the key finding and way forward. This chapter concluded with recommendation suggested for further study.

Chapter II

Methodology

2.1 Introduction

In this study literature review was carried out as background study of this thesis using various sources of written data. 6 case studies are conducted in two stages, stage A and stage B, conducted in order to study the user-shelter relationship among various income groups in urban centres of India.

"In a case study the researcher explores a single entity or phenomenon bounded by time and activity for example a process, building or a social group. However a case study does not make claims to be representative of a larger population. A variety of data collection procedures can be used to collect information about the case study"(Research Design and Methodology Approaches, MSC in Architecture Environmental Design of Buildings, WSA). However selection of appropriate methodologies is important in order to acquire the right and valid information required in order to proceed with the study. Research methodology is the procedural framework within which the research is conducted (Remenyi et al, 1998). In the 6 case studies conducted in this study, survey research method has been adopted. This chapter is provides an introduction to the methods used for data collection in the case studies. A more detailed description of the procedure undertaken is discussed in the individual case studies.

a) **Stage A Case Study I, II, and III:** uses the following methods of data collection:

- **Questionnaire (Set A)** survey to be used among case study households to find out what are the housing needs of the urban dweller and are these needs being satisfied, what are their concerns, preferences, what are the materials preferred and their level of awareness to present concerns of energy efficiency and sustainable development.
- **Structured (Set A) interview** questions to be used among of the case study households in order to find additional information on user shelter needs and concerns on various aspects of shelter in order to support this study.
- **Structured (Set C)** interview questions to be used to interview the planners who are part of the execution team or belong to the same organisation concerned with the execution of the respective case study housing cluster or settlement in order to receive input and gauge attitudes regarding present shelter issues and concerns,

sustainable development, technologies adopted, passive design, user participations and recycling in construction.

- **Site survey** to be conducted of the case study shelter developments in order to carry out site observations to gather additional information, take photographs, collect secondary data (Reports Published by private and public bodies concerned with the development of the respective case studies shelter units) and carry out the questionnaire surveys and conduct interviews of the inhabitants.

(**This study will focus on:** Middle-income, low-income group and economically weaker section shelter units)

Stage B Case Studies I, II and III: uses the following method of data collection:

- **Questionnaire (Set B)** survey to be used among the case study households in order to carry out investigation on why the formal and informal housing sector are not being able to satisfy the user needs of quality, comfort and affordability. In order to identify why awareness levels are low, why shelter programs and technologies adopted are not sustainable options and look into alternatives on how are they can be being addressed.
- **Structured (Set B)** interview questions to be used among case study households in order to get additional information and feedback on their lifestyles, general awareness, dissatisfactions and recommendations, which in addition to supporting the study will provide more insight into the user shelter relationship.
- **Site survey** to be conducted of the case study shelter settlements in order to conduct site observations to gather additional information, take photographs, collect secondary data (Reports Published by private and public bodies concerned with the development of the respective case studies) and carry out the questionnaire surveys and conduct interviews of the inhabitants.

(**This study will focus on:** Middle-income group public housing, low-income group, economically weaker section squatter housing and high-income group private housing)

2.2 Questionnaire survey:

Two sets of questionnaires have been developed for the purpose of this study, to be used for the stage A and stage B case studies, which are set A (refer to appendix 1) and set B (refer

to appendix 2). The questionnaires will be used to investigate the set of hypotheses developed for the stage A&B case studies respectively as depicted in figure 2.1 below:

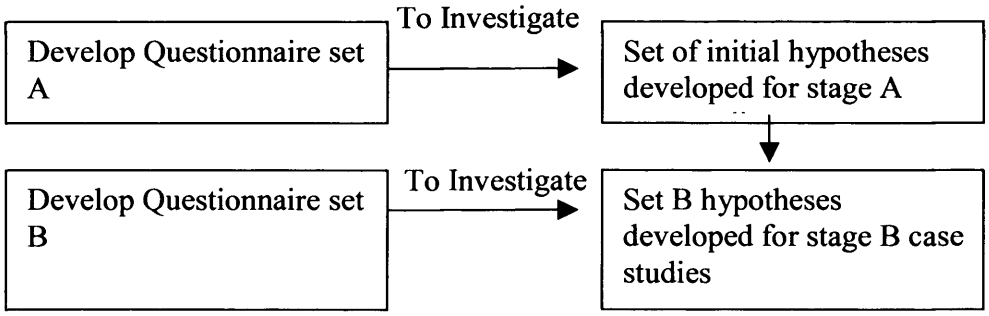


Figure 2.1

Set A questions have been developed to gauge user preferences, opinions and general awareness to various issues like building materials used, efficiency, general awareness and satisfaction levels. Set B questions delve into more detail on various aspects identified in stage A case studies. The nature of the set A questions are behaviour and attitude questions designed to find out what are the shelter needs, concerns, expectations, satisfaction and dissatisfaction levels among respondents, in addition to information on general awareness levels on shelter issues such as energy use, sustainability and building materials used. This set of questions is used in the study as a base for the development for the stage B case studies. Set B question were developed in order to find out more about the specific user needs identified from the stage A case studies in addition to inputs on their outlook, reservations and recommendations on ways to improve their shelter units. The stage B questionnaire was also designed with the aim to identify variables, which influenced user preference in terms of comfort, lifestyles, general expectations and shelter types of various income groups.

The questionnaire survey has been chosen as a tool for this study because it is a relatively inexpensive way to gather data from a potentially large number of respondents and is still large enough to allow statistical and straightforward analysis of answers to closed questions. However the researcher's control over how the questionnaire is administered is somewhat limited which means that the validity of the results is more reliant on the honesty of the respondent. Therefore it is more difficult to claim complete objectivity with questionnaire data than with results of a tightly controlled lab test. The questionnaire survey tool is however better suited for gathering reliable subjective measures, such as user satisfaction. Also, questionnaires can be used for explanatory or descriptive purposes or a combination of both.

The questionnaires developed for this study contain mostly closed format questions in the form of multiple choice tick box questions, since they are easier for the respondent to answer. According to one school of thought, for questions that measure a single variable (like to dislike, poor to excellent) there should be an odd number of alternatives. Closed set questions are easier to calculate percentages and are also easier to track opinion over time by administering the same questionnaire to different but similar participant groups. Few open format questions are also included in order for participants to answer what he/she chooses and for the researcher to receive more insightful suggestions regarding changes they'd like to incorporate in their shelter conditions along with queries concerning their health and well being. However, as far as possible most open-ended questions were also formatted in order to receive answers, which could be easily, number coded and converted to quantitative results. Closed questions were numerically pre-coded and the open-ended questions post coded and analysed post collection, all data to be converted into percentages and presented in the form of tables or graphs. (Examples of questionnaires design referred to from- Hofland John, Hofland Lyn H., 1995, Thesis case study on domestic fuel Sarala Gopalan 1989, Squatter settlement case study Vandana Desai 1995, www.cc.gatech.edu/).

According to Fellows and Liu, questionnaires are highly laborious on part of respondents and the researcher hence a further consequence is the low response rate (Fellows and Liu, 1997). In this study the questionnaire and the interview survey encountered the problem language and interpretation, along with barriers such as access to sites and households have resulted in low response. Hence investigations are supported by observations made during site visits.

The methods adopted for administration were face-to-face interviews and self-administered questionnaires. In the stage A case studies, questionnaire survey was conducted carrying out face-to-face interviews mainly due to the small survey sample size and time constrains of delivering and receiving the questionnaires. One advantage of adopting face-to-face surveys is the personal interaction between the interviewer and the respondent. However according to Bradburn, this method has been considered to be more open to bias introduced by the interviewer's behaviour, and because the personal contact engages general norms about self-representation that are considered to cause the respondent to distort their answers with the aim of making the answers more favourable to the interviewer. According to Bradburn based on his studies conducted 'there is no clear- cut advantage for any particular method of administration of the questionnaire' and that there is 'no one method clearly

superior to all others". Different methods of administration may be appropriate for various studies depending on considerations such as cost, access to the desired sample and ease of administration (Bradburn et al, 1979).

In stage B case studies questionnaires were delivered and collected at a later determined date and also via face-to-face interviews based on the appropriateness of the case study location and the participation individual, with respect to access and social group. In the case of the middle-income and high-income households the questionnaires were self administered since most respondents from this social group are literate. In the case of the low-income group and economically weaker section respondents since most of the respondents are not literate or more specifically literate in English but literate in Hindi, face-to-face questionnaire interviews were administered. Also due the difficulties encountered in translating some of the terms and variables the questionnaires were kept one language i.e. English and on-going translation were done during the interview based on the understanding of the respondent.

2.3 Structured Interview Questions:

Three sets of interview questions have been developed for the purpose of this study, set A (refer to appendix 3) and set B (refer to appendix 4) to be used to carry out structured interviews of the stage A and stage B respondents and is discussed in detail in the respective case study chapters III &IV. In both the stages A & B, the interview questions have been developed in order to gain more insight into the user-shelter relationship and use the data collected to support the case studies. Set C (refer to appendix 5) interview questions have been developed for the purpose of interviewing the planners and builders involved in the execution of the case studies or belonging to the same executing organisation and discussed in detail in chapter III & IV.

2.4 Site survey:

Site surveys will be conducted in order to study and make on site observations of shelter design, materials used and shelter conditions, which will be discussed in the procedure section of the case studies in chapter IV & V respectively. The additional purpose of the site survey is to conduct the questionnaire surveys and the structured interviews of the inhabitants. Site visits to the executing public and private body office blocks will also be made in order to conduct structured interviews of the planners and builders using Set C interview questions developed and collect written data for the purpose of the study.

Chapter III

Literature Review of Housing in India

3.1 Introduction:

This chapter introduces the background to housing in India, urbanisation and the gradual shaping of housing in Indian cities. The review is directed towards issues of sustainable housing development in urban India. For the purpose of this review data used has been obtained from government reports, various organisational reports, newspaper clippings, web pages, publications, journals and books.

Figure 3.1 below shows the aspects of sustainable development and the relationship between various aspects that will be addressed in the literature review:

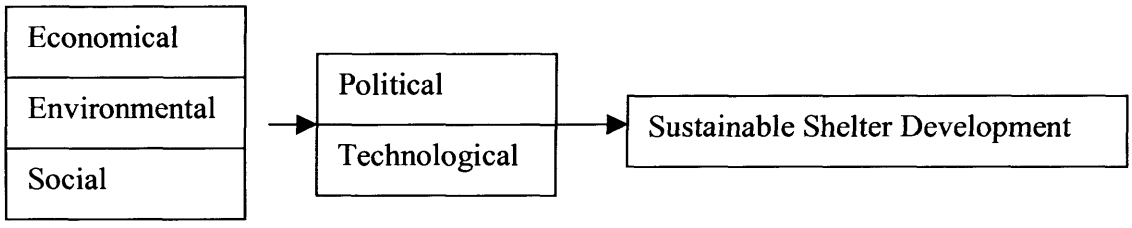


Figure 3.1

The figure explains the use of economic, environmental and social factors as variables of sustainable development, which can be achieved through application of political policy changes, and technological innovations, and these two can be referred to as the control variables. The dependent variable is sustainable development.

3.2 Structure of this study

The literature review will look at five aspects of sustainable housing, namely, social, economical, environmental, political and technological with respect local context and to an extent global context in order to gauge local needs and environmental concerns of various shelter issues and implications. The set A hypothesis developed will be tested in the literature review with the aim of identifying supporting evidence as well as the areas that need to be focussed on in the following case studies. In addition data gathered on local and global contributions, past developments will help in determining present and future scenario impacts on, and impacts to local and global shelter. This knowledge is aimed to inform the development of a structure and methodology for carrying out the stage, 'A & B case studies'.

The literature review will focus on the relationship between:

- Social influences and Cultural acceptability and feasibility of present shelter designs and its likely impacts on the quality of life of an individual.
- Economy and its relationship with shelter in terms of cost of shelter, employment, affordability and access to shelter.
- Shelter and the environment concerns with relation to resource inputs, energy use and waste outputs, in addition to the impacts on various environmental issues like global warming, consumerism, rising living standards on shelter design and comfort outputs.
- Shelter schemes/programs and their influence on the user shelter requirements and the course of sustainable shelter development.
- Technologies adopted and their influence on sustainable shelter.

Although the aspects given above are individual aspects, many issues within them may overlap and "understanding the links between the aspects (People=social, Profit=economical and the Planet=environmental) can develop lasting solutions" (Green Futures, March/April 2005).

Given below in figure 3.2 is the structure adopted for this study:

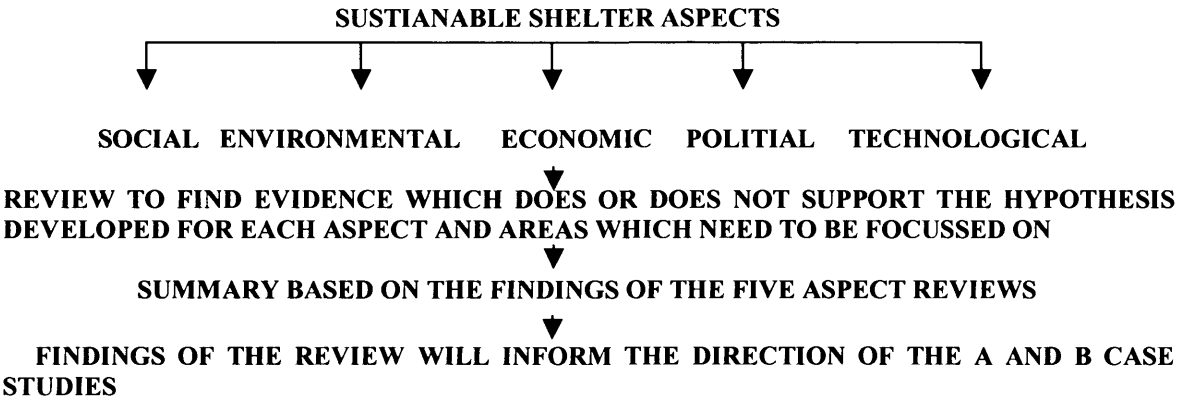


Figure 3.2

3.3 A Brief Review on Changing Face of Shelter from Past Influences of Culture and Tradition to Present Influence of Urbanisation and Poverty:

India is a country of diverse cultures and architecture has always been a medium of expression of cultural ideologies, and cultural prudence and traditional knowledge ensured that our natural resources were not over utilised (India: Environmental Priorities, 1991). The tradition of architecture in India today can be categorised into local, contemporary and

a hybrid of these two forms. "Most often the contemporary and the traditional appear in direct opposition to each other but can also create a harmonious synthesis, which is simultaneously both contemporary and timeless" (Herbert, J.M.Ypma, 1994). India is also familiar with the industrialized production of buildings, the monumental temples being built since ancient times have been constructed with industrialised construction principles involving modular construction and standard elements instead of casting with concrete. The elements being used like beams columns etc. are carved from stone and the shape and size of the pre-formed members are carved off site and assembled on site. These temples have withstood all the natural calamities like earthquakes floods without any damage for years (Sri P.M. Deshpande et al).

Indian architecture has always relied on local resources and each region has its own distinct from of architecture for example the desert architecture of Rajasthan is colourful and heavy while the architecture of the coastal region light and airy. In desert architecture locally available material like sandstone and marble etc. are more commonly used thus the structure and form are determined according to the intrinsic order of load bearing stone construction, spans were therefore short, the building chunky and diminutive (Appropriate Building Systems Instruction Manual, 1993). Houses built in the Thar desert in western Rajasthan had thick walls, which were made of locally available mud and stones which delay the entry of daytime heat into the building and it reaches the interiors by night when the temperatures are much cooler (Jon Lang et al, 1997). While in the northeastern part of India, which is more or less a hilly terrain, the summers here are mildly warm and humid, while winters are cold. The houses here also make use of local materials like bamboo, timber, mud and cow dung plaster. Bamboo is used in a woven form for walls and partitions providing good ventilation during summer. Traditional architecture can be described as an organic process, involving society as a whole and through centuries every society has succeeded in building shelters, which are in perfect balance between lifestyles and the built environment (Development Alternatives, 1986). But today the "subsequent disintegration of social institutions, breakdowns in information feedback loops, introduction of large-scale technologies and rapid changes in demographic and consumption patterns has led to the degradation and depletion of natural resources" (India: Environmental Priorities, 1991).

Recycling of materials, use of locally available materials and other inventive ideas for sustainable developments have existed in traditional houses for centuries based on a widely

shared and accessible technology. Traditional buildings also have provision for incremental growth or change without losing their identity. Today the building materials in most rural areas are made mostly of mud and classified as semi or non-permanent constructions (Aromar Revi, 1990). Figure 3.3(Charles Correa, 1999) below shows a typical veranda in a village which acts as a transition space between the indoors and the outdoors which is usually the space used to entertain guests and socialise, as for most cultures in India outsiders were only allowed to enter a certain area of the house. Most houses were built around open courtyards, which were used to entertain guests. This concept of open central courtyard is found in many traditional houses in regions all over India (Amos Rapoport, 1969).

Figure 3.3: Village Shelter

The availability of potable water has always been an important factor for the choice of a settlement and most villages like all civilizations have formed around places where there is a source of water body like lakes and rivers. In many Indian villages social life also forms around the local tap or wells where people gather to draw water and socialise with each other as seen in Figure 3.4 given below (Charles Correa, 1999).

Figure 3.4: Village water tap/well

Shelter in India has grown out of socio cultural needs like the projecting balconies with meshwork seen in figure 3.5 below were designed for the womenfolk to provide privacy along with security, shade, fresh air and prevented entry of dust. Elements like internal courtyards are also common in most parts of India, the rooms were inward looking, built mainly for privacy and also kept the house cool, reduced dust and noise from coming indoors (Herbert J.M.Ypma, 1994). The Indus Valley has extremes of climate; during the hot weather in order to keep out the afternoon wind and dust houses were clustered together with fewer openings. In order to catch the breeze the rooftops were made of uniform height allowing the breeze to blow over the entire city without obstruction and people could sleep on the terraces at night. During winter the minimum number of openings avoided the draughts and sitting out in the courtyard the warmth of the sun was enjoyed. This shows that builders of the past designed buildings, which were not only aesthetically appealing but socially and climatically sensitive as well (Buch.N.M, 1991).

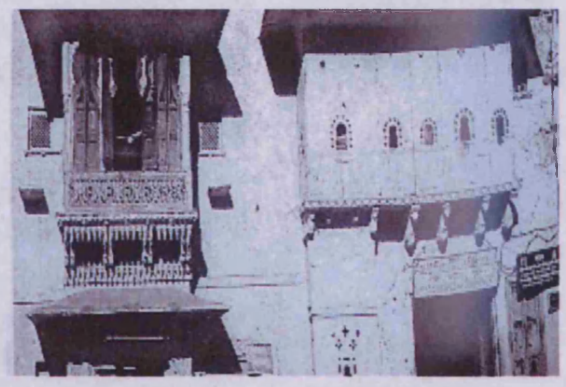


Figure 3.5: Traditional House in Rajasthan

These examples show that ancient architecture had many passive features. Indigenous buildings have used traditional and locally available materials, like mud and thatch, which can be more cost and energy effective. The earlier examples of traditional buildings demonstrate that significant ecological benefits can be achieved by low energy building types and through design efforts, the use of sustainable materials, and planning within the environment. But over the years Indian buildings have has moved from the use of passive systems in building to mechanical systems. Not only are indigenous methods of construction are slowly disappearing giving way to modern buildings and buildings today are mostly constructed with non-renewable, as well as costly, building materials such as cement and steel (Herbert J.M.Ypma, 1994). But due to the present the energy crises, climate change and the impacts of energy use in shelter more and more efficient and

passive systems are being researched upon and adopted in buildings by various institutes like TERI, HUDCO and various private builders and architects. The picture of Indian cities is also changing under the impact of city development plans such as master plans, housing board layouts, slum clearance programs and redevelopment of urban villages. Although new concepts in planning have been adopted by some planners and non-government social organisations in order to improve the quality of housing, most builders as well as users today only consider a few aspects: price, durability, and the social status of the product. Energy use, long-term costs and environmental consequences are of lesser concern (TERI, 2000). As the environmental conditions affect the quality of housing and the households, households and their consumption patterns affect the environment from air to water pollution and climate change to resource depletion and therefore the choices made by the people are of major significance to them and the environment.

Barbaric city sick with slums,
Deprived of seasons, blessed with rains,
Its hawkers, beggars, iron-lunged,
Processions led of frantic drums,
A million purgatorial lanes,
And child-like masses, many-tongued,
Whose wages are in words and crumbs
Nissim Ezekiel

This section of the poem by Nissim Ezekiel aptly describes the condition of most urban cities in India today and the positive role of urbanisation has been undermined by the deterioration in the physical environment and poor quality of life in the urban areas caused by widening gap between demand and supply of essential services and infrastructure. "The Twentieth Century has been a period of astonishing growth, both in terms of the world's population and in terms of mankind's capacity to exploit his surrounding environment". Although urbanization in India has been relatively slow over the past fifty years as compared with many other developing countries, India has experienced rapid growth of population during the last four decades and the growth of urban population has been nearly double as against the natural population growth. Urban population registered almost four-fold increase between 1951 and 1991, which is 217.6 million in 1991 as against 62.4 million in 1951 (HUDCO, 1999). As economic activities tend to concentrate in areas with the best infrastructure and the highest level of economic development, which mainly revolve around major cities, workers migrate to these urban areas. " The industrialisation of

a country generally leads to the migration of people from rural to urban centres. According to a survey sponsored by International Development Research Centre, India part of Micro Impacts and Macro Adjustments Policy Survey 94/95 empirical results shows wide disparities in levels of economic and social indicators in rural and urban India. There is a widening gap between shares of income in rural and urban areas in the last two decades. Empirical results also show a higher degree of deprivation in social indicators of the poorer section as compared to the higher income groups (Pradhan B.K. et al, 1998). This process puts pressure on the urban infrastructure, causing social, economic and environmental disruptions" (AIESEC, 1990). This growth in urban population is mainly due to in-migration to urban centres accounting for 50% of the population increase every year in the prospect of better opportunities, family ties, education, employment and higher income opportunities and most of the growth arising from the enlargement of existing towns at every level, rather than from the addition of new towns. (Fact Sheet, 1999). "Between 1985 and the year 200, Third World cities could grow by another three quarter of a billion people. This suggests that the under-developed world must, over the next few years, increase by 65% its capacity to produce and manage urban infrastructure, services and shelter just to maintain today's often extremely inadequate condition" (Dr. Hernando Valencia Villa, Deputy Judge, Supreme Court of Justice, Colombia. World Theme Conference Speaker, AIESEC, 1990). According to the 2002 population census, India's urban population is over a billion at present and the scale is becoming so large that the country will have to give much greater attention than it has done in the past to devising policies and solutions which will enable the country's urban system which includes shelter and infrastructure to cope with such growth.

Already the majority of the population in India rural as well as urban do not have a shelter that provides minimum privacy and protection from external elements and ill health. This is especially the case with the low-income and economically weaker groups of the community, which causes increased demand for low-costs housing, which further strain the urban infrastructure. The inability to gain employment by many migrants often results in the inability to afford housing and end up living in squatters (AIESEC, 1990). Based on the 1991 census figures the estimated housing shortage was 22.90 million units and more than 90% of the shortage was in respect of the poor and low-income categories. This shortage along with the autonomous growth in housing demand during the 'ninth plan', would require an investment of Rupees 1,15,000 crore (1 crore=10 million) and it was estimated

that urban infrastructure would alone need Rupees 2,50,000 crore in the next ten years and only 10% of this would be available from Government sources (S.P.Talvar, 1999). Although there is a lot of potential demand for housing in India, it is not affordable by many prospective buyers. To solve this problem it is necessary to ensure easy finance to the buyer at reasonable costs and to improve the affordability by reducing prices (S.P.Talvar, 1999).

Housing remains a problem in most parts of the world, if not quantitatively, at least qualitatively. In India the problem is both, and a significant reason for the problem could be the rapid population and rapid urbanisation. As the large inflow of people into the urban areas has put more pressure to carry out housing requirements, housing of this scale requires massive availability of building materials. At present most builders use brick and cement for construction, and these materials use large quantities of fuel for manufacture. The introduction of alternate and re-use technology in the housing sector, has shown potentialities of cost reduction and mass production however it still needs wider acceptance and large scale implementation (K.Thomas Poulose, 1988).

India and other developing countries like Nepal and Sri-Lanka face similar pressures to meet the demands for land, shelter, infrastructure and services as a consequence of urbanisation (Om Prakash Mathur, 1999). In developing countries, issues like rising external debts, limited financial resources, unemployment, poverty and poor living conditions require urgent attention. In addition urban areas in developed and developing countries are facing global consequences of environmental pollution and degradation a result of resource intensive lifestyles, technological inefficiencies and increasing fuel consumption. In the case of India as a consequence of urbanisation, the contribution of non-agricultural sectors like industry, manufacturing and services to the gross domestic product has risen from 55% in 1970 to 68% in 1999 (World Bank. 1994) and if properly managed, can develop the capacity to sustain their productivity, manage natural resources in a sustainable way and most importantly improve the living conditions of the population (Harbans Singh Gill et al, 1999).

By the year 2000, 12 per cent of the world's population will live in mega cities and sixteen of the world's largest urban areas will be in Asia.

World Development Report (1995)

Source: HUDCO-HSMI, 1999

3.4 Aspects of Sustainable Development:

Development embodies personal aspirations, ideals and concepts comprising of what benefits a society and the need to reconcile social and economic development with environment responsibility. In order to sustain the resources for the present and future generations, it is important that minimum resource requirements are used for development. Thus sustainable development in practice is finding the middle ground between economic growth, environmental responsibility and social acceptance. Hence development activities must neither degrade nor deplete the national resource, nor have serious impacts on the global environment, and also be culturally acceptable and socially viable (J.N.Singh, 1997). Since development depends on economy, environment and people's interaction with one another, focus on only one aspect in inappropriate. Sustainable development is the balance between environmental consideration, which aims to protect natural resources and improve economic, human and infrastructure development (WWF, 2002). Too much emphasis on environmental aspects will limit the possibilities of economic growth particularly in the developing worlds while too much emphasis on the economic aspects will lead to the depletion of resources that cannot be readily renewed. Scientists at the Cold and Arid Regions Environmental and Engineering Institute, Lnazhou have discovered that in the last five decades the area converted to desert in Northern China has increased and similar concerns have been expressed about the Thar desert in Indian, owing to over ploughing, grazing and deforestation and the responses like tree growth are not sufficient (R.Rajamani, 2003). WWF has recommended four fundamental changes necessary to switch to a sustainable path, which are stated below:

1) It is necessary to improve the resource efficiency with which goods and services are produced
2) We must consume resources more efficiently and redress the disparity in consumption between the high and low income countries
3) Population growth must be controlled by promoting universal education and health care
4) It is imperative that we protect, manage and restore natural ecosystems in order to conserve biodiversity and maintain ecological services in order to conserve and enhance the planets biological productivity for the benefit of present and future generations

(WWF publication on living planet report, 2002)

Sustainable development is not new concept in India, local traditional architecture has many passive features for example in hot dry areas of northern India, walls are made of stone which delayed the entry of daytime heat into the building and reached the interiors when it was cooler. But what is needed today in the incorporation of these old concepts in the context of an evolving urban society and strike a balance between the old and new concepts (India: Environmental Priorities, 1991).

As mentioned in the points given above by the WWF publication, sustainable development also highlights the relationship between local and global, the developing and the developed and the need for collaboration between countries and sectors by readdressing the disparity in consumption between the high and low-income countries, and provide a platform for transfer of technology and building capacity to enable developing countries to jump directly to resource efficient and sustainable systems. Along with promoting efficiency and reducing pollutions, Government and industries should take responsibility for their actions and engage in actions such as ecological reconstruction of environments destroyed by mining and other such activities. One definition of sustainability is that "it should incorporate the means to sustainability"(R K Pachauri, 2000). Means to sustainability can achieved through government policy support like granting subsidies to industries with long-term sustainability systems, enforcing tax on environmentally polluting industries and recycle the revenues into subsidies that encourage sustainable production industries, promote markets for efficiently produced goods and simultaneously promote education and healthcare to control human population (WWF Publication, 2002)

"A sustainable habitat design is an economically viable solution with minimal environmental footprint that can drastically reduce energy demands in buildings by 30 to 60%" (Dr Ajay Mathur, Dean, Energy-Environment Technology Division, Teri, 2000). This can be achieved through reduced fossil fuel demands, reduced emissions, reduced pressure on natural resources like water, reduced waste generation and simultaneously recycling scarce resources (TERI, 2000).

3.4.1 Social Aspects of Sustainable Shelter: This section will discuss factors relevant to the social aspects of sustainable shelter, which include social and cultural influence, needs and practices and shelter user relationship in terms of participation in order to identify the links between shelter, user satisfaction and socio-cultural needs of people.

Social Hypotheses *Urban housing conditions do not satisfy the general housing needs of the dweller.*

Present Condition: As already discussed in the previous sections, rapid urbanisation along with rapid population growth in India has lead to a lot of problems, which include shelter inadequacy. The housing problem does not confine itself to housing shortage alone but the problem of unhygienic environment, poor access and provision of basic services like water, electricity and waste disposal. Recent surveys done by nongovernmental organizations like Development Alternatives and Tata Energy Research Institute along with current discussions seem to suggest that condition of housing has deteriorated since the nineteenth century. Especially, in squatter settlements where even basic services like clean water and sanitation are not adequate. In addition the condition of the external environment has also deteriorated for instance the level of pollution is rising in urban centres due to gasses contributed by city transport systems, solid waste, untreated sewage and chemical used by industries. Also the noise pollution level is much higher than prescribed limits, 35 decibels for households and 50 decibels for work places (Harbans Singh Gill et al, 1999). The absence of adequate shelter and services has a bearing on the physical and mental well being of an individual as well.

In addition "Deteriorating urban environments where the urban poor are deprived of basic services and security of tenure leads to social frustrations, which can lead to a culture of violence" Klaus Topfer, Executive Director, UNCHS (Habitat) (Dr Kulwant Singh, 1999). Shelter not only provides security and a sense of well being to the inhabitants but can also help tackle issues of population, as by improving living standards and opportunities, couples will be more receptive to the idea of smaller families (AIESEC, 1990). Therefore shelter is a very important aspect of human development.

Socio-cultural influence and practices: As already discussed in this study, architecture in India is a product of social and cultural influences and climatic needs. Discussed in chapter one, features like the internal courtyard and verandas provided cool conditions and still are popular spaces for entertaining and socialising. Indoor spaces have also evolved from gender influences like the need of privacy and the use of net on windows and balconies in traditional houses are good examples of such social needs. The system of purdah is common among Muslims, which was developed to keep women secluded in a space safe

from unregulated sexual contact. Throughout history a variety of cultural, religious and ideological reasons have been used to create spaces catered for and to justify gender segregation. Spaces in architecture have also been used to maintain status distinctions by gender (Daphne Spain, 1992). Traditional courtyard pattern of the Nigerian Hausa used by both Muslim and non-Muslim families also differentiate men and women spaces (Moughtin J.C, 1985). According to Hillier and Hanson "the spatial structure of buildings embodies the knowledge of social relation". Thus dwellings reflect ideals and realities about the relationship between men and women within the family and also in society. "The space outside the home becomes the arena in which social relations (i.e., status) are produced, while the space inside the home becomes that in which social relations are reinforced" (Hillier and Hanson, 1984). Hence shelter provides households with protection, security and privacy from external elements but also the spaces within provides privacy to the members of the household from each other.

Already discussed in chapter one community and communal spaces are also am important aspect of shelter and shelter planning in India. Social activities and festivities and decisions regarding their town/village involve communities coming together in one place (open or covered space). This is still very evident in rural communities and to some extent among the low-income group squatter dwellers.

Another characteristic of rural developments in India is self-sufficiency; where all needs of the community came from local skills and resources. Since mostly local materials were used, re-used and organic waste generated was minimum and mostly biodegradable. This suggests that recycling is not a new idea in India and has been a part of Indian society in the form a network locally known as rag picking. Individuals known as rag pickers go from household to household collecting domestic waste in exchange for cash or kind like utensils. Municipal solid waste is also collected and the recyclable content of waste ranges between paper, plastic, glass, rubber, ferrous and non-ferrous metals are salvaged from waste to produce low-cost products extensively used by the low-income groups of the society. This means that some of the households waste is being recycled or re-used cost-effectively. However the network of rag collectors is not an organised network and they do not have the skills of technology to segregate and recycle most of the waste generated- the result over spilling of landfill sites. In India the rate of organised recycling is also very low and data collected from 44 Indian cities in 2000, revealed that about 70% of these cities do

not have adequate capacity for collection and transportation of municipal solid waste (TERI Newswire, 2000). Also at the domestic level waste is not segregated and thus not suitable for recycling. As a result most materials like scrap aluminium are imported. Even though recycling of aluminium only requires around 5% of the energy used in primary aluminium production. (VidyaS Batra, www.teriin.org). The mixture of different kinds of household waste has encouraged some countries to ask its citizens to separate the waste at its source in order to facilitate recycling and composting (AIESEC, 1990) which already sort of exists in the form of the informal rag collectors but needs be formally integrated with the municipal bodies. What is needed is a more organised and safer system for the rag pickers as well as proper coordination with the households. At present the rag pickers go at random from household to household which is a disorganised system and lacks effective management. The issue of safety must also be of high concern as the these rag pickers are likely to handle all kinds of waste like sharp objects, infected needles etc with no access to protective gloves. An effective solution for all these problems would be to create some kind of a formal network for them run by an organisations providing management along help and safety guidelines and access to gloves etc, skills and technology for recycling.

Recycling and re-use also exist at the shelter construction level among the economically weaker households and the low-income groups in the squatter settlements where materials salvaged from construction/demolition sites and landfill sites are used to build shelter. Re-use and recycling materials not only reduce energy use and pollution compared to production of new materials they also reduce the need for landfills, and pollution from incineration. Today many materials and components are now also available in the market that have recycled or waste product content like fly ash based light weight aerated concrete walling roofing blocks (HUDCO, 1999). Fly ash is ash generated in Indian thermal power stations and poses a serious threat to the environment and can be tackled by using fly ash in building construction which is stronger 100 kg/cm sq compared to brick which is 50-75 kg/cm sq, and smoother on the sides reducing plastering costs significantly. These blocks are naturally dried and therefore environment friendly. They also do not use the top fertile soil of the earth like other building materials and thus protect the land for agricultural use (TERI Newswire, 2000). Architects and designers can also contribute to the popularity and promotion of recycled and innovative materials by using such materials in their designs.

As waste is only worth recycling if there going to be a use for it, so the market value of recycled waste is important and revenue generated can contribute to the collection system and other community welfare activities (Ten Awardees, HUDCO, 1999). Thus it is important that people are adequately informed about issues like re-use, recycled materials and energy conservation concepts in order to broaden the scope for recycled materials and energy conserving buildings from special projects for motivated clients to everyday buildings, as no amount of careful planning and design will work unless the user is ready for it, only people can turn thoughts into action (TERI, 2000). "It is people who make the decisions about selections and applications and their lives which are affected by these decisions" (Jean McNiff, 1988). In order to achieve sustainable development it is crucial to change peoples' present values and behaviour and in order to change their consumption patterns it is important to increase their awareness (AIESEC, 1990).

A successful example of the use of the existing network of garbage collectors is the zabbaleen garbage collectors in Cairo, who are not only selling products made from garbage they have collected and recycled, but are successfully influencing government policies for the urban poor. The zabbaleen collect and recycle over 600 tonnes of household waste a day approximately one third of the waste produced by the residents of the city and the revenue generated from the recycling activities have been invested in housing, infrastructure and basic services thus contributing to the health and welfare of the community. This project is a joint effort of the private sector and the NGO's and is an excellent example of how solid waste collection can not only become an income generating activity among marginalized groups but also help improve the urban environment and the living conditions of the urban poor (Ten Awardees, HUDCO, 1999)

Another good example is in an urban city of South India called Exnora for solid waste management in Madras, which has generated the system of garbage collection while retaining the role of informal rag pickers enabling them to receive salaries contributed by the residents and 500 members are working with around an average of 75 households. Exnora also works to generate public awareness through active participation and has evolved as a cost-effective and self-sufficient system and also works with slum areas of Madras (Menon A, 1993, Mehta Meera, 1999).

Community Participation: "Any development process that does not reflect the thinking and culture of the people for which the process is designed is not likely to succeed..." (Mr

Kafi Totobi Quakyi Special Assistant for Political Programs and Acting Secretary for Information, at the Ghana AGSS seminar, January 1990, AIESEC). At the world conference policy at Rio in 1992, UNCED firmly endorsed strategies that involved local communities as a key factor in both visual and eco system management (UNCED, 1992)

In the Rio De Janeiro summit in 1992, community participation in environmental programmes at all stages is stressed, as in the development of sustainable city networks to encourage international information sharing on initiatives. With respect to shelter as well "Unless the subjective dimension is recognised there is little human value in housing" (Desai, 1995).

Johnson identifies five different kinds of citizen participation in the planning process- i. Constituent participation is that through democratically elected representatives, ii. Consultative participation is the communication of proposals to people through notification, public hearings and the opportunity for representation to be made of the kind provided in Britain by 1968 Act, iii. Definitive participation is direct involvement in the decision making process through referenda, iv. Implement participation in the citizen determination of the outcome of planning or policy discussion, v. Evaluative participation is the public response to planning discussions through appeals (Johnson W.C, 1984)

Community participation in local governing structures can make people more involved in working towards common goals and improving their environment and urban conditions. This would lead to the recognition and use of local employment opportunities and open the scope for more relevant services as people know what is needed but lack resources to enable them to act (AIESEC, 1990). (Menon A, 1993, Mehta Meera, 1999). During the eighties focus was directed towards greater public participation and promotion of self-reliance among the poor with recognition of the need to shift benefits of the housing programme from the formal sector to the economically weaker sections (Aromar Revi, 1990). However often community involvement in the decisions which affect their community is not facilitated by the system of local administrators (Desai Vandana, 1995). In the case of urban areas most citizens are removed from the political processes as the urban areas are much bigger is scale, therefore alternate structures should be developed which encourage more effective participation of citizens especially among the poor and the

women. The government on their parts should be more transparent in terms of resource allocation (Menon A, 1993, Mehta Meera, 1999).

The significance given to the importance of participation is reflected in the resolution passed on agenda 21 which is to promote sustainable human settlements development at the UNCED conference in Rio de Janeiro in 1992 and emphasises on basic needs rather than only growth maximization, an alternative development that emphasises on a people centred development that begins at the local level. Participation recognises the need for community control and empowerment and the need to transform governments through cooperation and collaboration with different stakeholders of the civil society. Shelter developments should emphasise on people centred developments, which embodies equity and environmental sustainability. "The object of participation is not to have an absolute but increased and, ideally, a balanced control over decision-making or resources" (Desai, 1995). According to Mehta, the objectives of participation effectiveness, efficiency, cost sharing, capacity building, coverage, community awareness, empowerment and equity in the areas of development projects, local services and public policy and planning (Mehta Meera, 1999). Participation would encourage effectiveness though better understanding of user needs and preferences, equity, and empowerment, greater satisfaction due to involvement and also help generate awareness. According to the annual report of 1999-2000 by the Ministry of Non-Conventional Energy Sources, for any new technology or device to succeed a large extent is dependent on the public awareness of the advantages of the technology. Hence it is highly important to generate public awareness through effective dissemination of information (Annual Report, Ministry of Non-Conventional Energy Sources, 1999-2000)

3.4.2 Economical Aspects of Sustainable Shelter: Although there are many issues within the dynamics of economic aspects of shelter this study is limited to aspects concerning user affordability and accessibility to shelter such as employment and cost of shelter.

Economic Hypotheses *Basic housing in urban area remains inaccessible to the masses due to high shelter costs and budget constraints of the households and public sector shelter providers.*

Present Aspects: " In the developing world decisions are often taken to exploit energy sources irrespective of the environmental consequences whether for domestic consumption

or more usually to gain hard currency" and " Governments will often drop pollution standards when faced with a choice opportunity of short-term economic gain for their country" (AIESEC, 1990). Economic development has been the main objective of India since its Independence, in order to sustain the fundamental needs of the growing population. Hence immediate concerns for sustenance will continue to take precedence over long-term environmental considerations (India: Environmental Priorities, 1991). However rapid growth and economic needs are dependant on short-term development solutions which are going to have long-term negative impacts e.g. eating into the valuable natural habitat and making intensive demands on the environmental resources, such as quarries for building materials will affect land resources necessary for future generations to grow food (www.wwf.co.org). India's GDP during the past three decades has been an average rate of 4.9% but due to economic reforms in 1991 it grew to 6.7% in 1992-96 and then going down due to the South–East Asian crises in 1997 and averaging to 6.1% from 1997-2000 (www.teriin.org). The rise in population will put more pressure on not only the resources but also on social services and employment sector and all the major problems like deforestation, soil erosion and over grazing can be traced to two main factors which are poverty and rapid population growth. According to Registrar General of India, report by the year 2050 A.D. India could become the world's most populated country (India: Environmental Priorities, 1991). Although population growth is on the rise, reaching over one billion in 2000, the employment sector has not kept pace with population growth. "Employment generation is an issue of life and death for our democracy" (Amit Mitra, Secretary General of the Federation of Indian Chambers of Commerce and Industry). An example showing the unemployment crises is when India's largest employer the Indian Railways advertised for 20,000 jobs with a monthly salary of rupees 6000 (around £73) in 2003, there were around 600,000 applicants which led to violence and even death in some parts (Reuters.com, Surojit Gupta, 19 April 2004). The planning commission report states that nearly 35 million people are registered with unemployment exchanges, which has risen from 27 million 4 years ago, and in order to curb the growth around 60 million more jobs have to be created in 5 years. Thus the difficult phase the economy of India is undergoing has to be dealt with urgency and immediate action, directing economic development toward short-term solutions. However problems of unemployment and economic development are long-term problem and which can only be addressed by consideration to long-term impacts such as resource depletion, energy costs due to inefficiency of short-term rapid

development. Hence sustainable development in India requires designing and implementing income generating natural resources and management activities. That will also aid in improving the purchasing power of the vast population and enable them to fulfil their basic needs and help them to get out of the poverty conditions (India: Environmental Priorities, 1991). Housing is not only a basic necessity; it has tremendous employment opportunities and promotes economic growth. Although "Every year Delhi needs an additional one hundred thousand houses, the Delhi Development Authority however built less than five thousand houses a year" (Shri Atal Bihari Vajpayee, Shelter 1999). Hence the Urban Affairs Ministry has now ended the monopoly of DDA and is encouraging the private sector to build most of the required houses. Also the National Agenda for Governance has pledged to facilitate the construction of additional 20,00,000 houses every year of which 700000 in urban areas and the rest in rural areas (Shri Atal Bihari Vajpayee, Shelter 1999).

"In some countries like Zaire, Thailand, Haiti, sheer economic stagnation is responsible for the gap between the town dwellers and jobs: but in Brazil, India and Mexico, labour surplus in towns has been exacerbated because their industrialization programmes are based on imported technology, which is capital intensive and employs few workers" (A Geography of the Third World, 1983, AIESEC, 1990). According to the planning commission a certain extent of the unemployment crises is due to the policy of shedding excess labour in both private and public sectors as companies have stepped up investments in plants and machinery more than in labour intensive industries. But according to the Montek Ahluwalia task force as well the S.P. Gupta special reports on employment the major reason for the decline in employment from the late nineties is the sharp decline in agricultural employment (Business Standard, msn.co.in). This decline of agriculture in India has been depicted in the table 3.1 given below (World Bank, 1994, World Development Report, Om Prakash Mathur, 1999).

Year	Agriculture	Industry	Manufacturing	Services
1970	45%	22%	15%	33%
1990	32%	27%	17%	40%

Table 3.1

In the 1993-94 to 19999-2000 period employment growth in the manufacturing sector went up from 2.26 per cent per annum to 2.58 per cent. According to some simulations carried out by the Gupta group, "shifting the cropping pattern to more labour intensive crops, promoting more horticulture and floriculture, greening of degraded forest areas and

wasteland would create an estimated 10 million new jobs from the farm sector". For example, the regeneration of 10 million hectares of forest land would create at least 1.5 million jobs, and increasing horticulture production from the present 148 million tonnes to 268 by the end of the 10^{th} plan would require 13,000 crores (1 crore= £130,000 approx) of investment and would generate 1.2 million jobs (Business Standard, msn.co.in).

The migration from rural to urban areas for better employment opportunities indicate a failure of the rural economy and the extent of the rural economy stagnation can be seen in the growth of urban slums. The planning commission estimates that around 50% of the rural population live below the poverty line. The problem of poor quality life does not confine itself to unemployment alone, a large percentage of those employed also earn minimum wages and cannot afford basic needs particularly in the midst of rising costs and inflation. According to the national commission on urbanisation it was estimated that only 7% of households earned more than rupees 3,000 per month (1 rupee=£80 approximately) and therefore have an affordable capital excess of rupees one lakh (100,000). The economically weaker section shelter financed by HUDCO a public sector institute costs Rupees 8,000 which means that public housing is below the affordability range of the urban poor i.e. 30 percent of the urban population. Which means that housing polices do not include the poor in public housing. Since almost all of the high-density high-rise structures constructed by the private sector are all priced over rupees one lakh, only 7% of the households have access to such housing. Also well-serviced areas are located where housing for the affluent are located around 93% of the urban population are deprived of access to land and shelter and basic services (Buch.N.M, 1991). According to official report by HUDCO, construction costs have increased over the years at rates much higher than inflation and the cost of basic conventional materials like cement, steel brick and timber increase the costs by around 13 to 15% annually while inflation is in single digit. The income levels of people are more or less in line with the levels of inflation through indeed rise in salaries. This indicates that housing is beyond the affordability limit of the majority of the people. In order to reduce costs the plinth sizes and the nature of the specifications are compromised and yet the constructions costs with respect to just a normal house have increased from around rupees 1000/-per sq.m. to as high as rupees 4000/-per sq.m (£1=Rupees 80 approx). Higher levels of costs around rupees 5000/- to 7000/-per sq.m have been registered for houses with better finishes and amenities. Construction costs can be reduced to affordable standards by adopting appropriate and cost-effective

technologies and construction systems and technologies developed by many R&D organisations. Initiates by organisations like Central Building Research Institute (CBRI), National Environmental Research Institute (NEERI), Development Alternatives and works by Laurie Baker have shown how houses and buildings can be built using various technology options and construction techniques to make savings of 20 to 405 over conventional costs. Despite these qualities cost-effective ways have remained within the confines of the laboratory (Indian Building Centre Movement, HUDCO).

Poverty and its Impacts on Shelter: A quarter of the world population lives below the poverty line and one third of it resides in India. Therefore in India eradication of poverty and reduction of income inequality has always taken priority. However case studies from various countries show that increase in income is not the sole basis of poverty eradication. Countries like China, Costa Rica, Sri Lanka, Columbia etc have been successful in translating their incomes into quality of life of people. Their human development rank is much ahead of their per capita incomes (Pradhan B.K. et al. 1998). In India about 37% of its population, which is around 340 million, one of the highest in the world, below sustenance level (Shashi Jain, 1999). While resource intensive lifestyle choices and consumption patterns in many developed countries are having severe impacts on the environments resource base, in India, resources and energy are required in order to deal with just the basic problems of food and shelter, which includes inadequacy of infrastructure services and space. The population density of India has increased substantially over the last few decades and the land/person ratio is becoming unacceptably low especially in the urban areas. The cities of Delhi and Mumbai alone account for more than 6 lakh migrants every year mainly because of work opportunities but once they come, they largely remain unemployed or end up in informal jobs. As a result a large percentage of urban population occupy land and use the city services without contributing to the city revenue. Also a great deal of the government funds are invested in economic activities especially in the secondary and tertiary sector and because of overall resource constraints only a very low percentage of the central government expenditure is allotted to housing and housing amenities (Buch.N.M, 1991). Hence although urban centres have grown in size order to accommodate the population increase, despite increased pressure housing and other amenities have not increased accordingly (India: Environmental Priorities, 1991).

As mentioned before, a large percentage of the urban population live below the poverty line and are still living without a proper shelter, as land is scarce. Thus many homeless millions

encroach public land and all types of vacant spaces and built shelter units using scrap such as plastic sheets, paper and old bricks and wood. This is due to the high cost of land, building materials, energy and a slower pace of economic growth as compared to the population growth due to which the purchasing powers are not keeping in pace with the rising cost of construction and inequality in the distribution of wealth between different groups of people and countries. "Real estate process and rental have also increased tremendously making it impossible for even middle class families to afford houses and unauthorised colonies from violating laws, and those who cannot afford even unauthorised colonies set up slums" (Sri Atal Bihari Vajpayee, Shelter, 1999). At the existing costs, the majority of the people in India are not able obtain even their minimum requirements which includes housing. Thus along with the need to assure easy finance and fiscal incentives, the use of cost reduction technology should be promoted in shelter construction in order to reduce the existing levels of costs and optimise resource efficiency (S.P.Talwar, Shelter, 1999). According to some estimates nearly 50% of the plan outlays are spent on construction out of which half goes to the construction of buildings, thus resources used for construction of buildings form a very substantial part of the total investment in the economy. Moreover any saving achieved would ease a lot of the pressure on resources as well as the budget for the country (K Thomas Poulose, 1988). " Completing the shortfall of 3.3 houses during the ninth plan period will costs Rupees 1,50,000 crores. The Government cannot afford to spend so much money. We need to find partnerships between the private and public sectors to find ways of raising this money (Shri Atal Bihari Vajpayee, Shleter, 1999). Therefore on one side India faces the problem of providing shelter for masses and on the other it faces financial constraints and scarcity of resources. Avoiding waste, adopting appropriate technology, evolving innovative designs and achieving efficient construction management can achieve cost reduction and savings through cost reduction could be used to provide more shelter units. One significant constraint in providing adequate shelter is cost and affordability and the present structure adopted by the public and the private sectors is to adopt conventional structure of brick and cement and reduce the cost by lowering specifications. Hence the carpet area is reduced, the walls thickness is reduced, plasters eliminated the accessories used are of low quality resulting a high cost low quality housing (Buch.N.M, 1991).

The collective per capita income of the underdeveloped countries is estimated to average less than one-sixteenth of the per capita income of the developed countries and the

inequality in the distribution of income between the rich and the poor are estimated to be higher in the developing countries than in the developed world. The poorest half of the people in the world are estimated to have accounted for less than 15% global GDP in 1992 and 15% of the highest incomes accounted for 50% of the global GPD. In order to achieve the general well being of the people the income gap between the poor and the rich, food gap, value gap and gap in level of education have to be reduced (Dr.C.Ramachandraiah, 1999).

The increase in urban population mainly due to the rural urban migration can also be attributed to rural-urban disparity in income distribution, which has widened thus without tackling rural poverty the urban living environments cannot be improved. The urban per capita income, only 1.6 times the rural figure, rose to 2.74 in 1982-83, and the urban per capita is estimated to have grown by 135% as against only a 30% rise in rural incomes in the last forty years since 1950. Around 67% of the rural households have less than Rupees 12,500 of annual income per household and 92% have less than Rupees 25,000 per year (Dr.C.Ramachandraiah, 1999). The Eight five year Government plans projected that urban India would contribute to GDP of around 60% by 2001 but the gains in income would be shared mostly by 30% of the urban population (Harban Singh Gill et al, 1999).

The Economic and Social Survey of Asia and the Pacific in the 2000, has projected the rate of growth in GDP of 6.9% and an average inflation rate of 6% for India in the year 2000 (TERI Newswire, 2000).

Like the rise in unemployment rates the shortage of adequate housing is also on the rise and we need to plan and build residential developments that provide not only basic amenities but also income and employment generation. Sustainable development can only be supported by complimentary activities in areas such as creating employment, equality, education, and industrial development, R&D and optimised the use of recourses.

"....economic development cannot be measured solely in terms of level and growth of overall income or income per capita; one must also look at how the income is distributed among the population- that is, at who benefits from development. "(Economic Development in the Third World, 1989, AIESEC)

For people to make sustainable development a part of their daily lives, it has to be a part of their local economy of which they are an active part (TERI vision, 2000). A good example of this approach is the Kipepeo (Butterfly) project in the Arabuko forest in Kenya which is an island of bio-diversity in a sea of poverty harbouring a number of globally threatened

species and surrounded by farmers whose mean per capita income was less than $50. A survey done in 1991 of those living near wanted to chop down the forest owing to wildlife crop raiding and the need of more land. But the Kipepeo project responded to this challenge by proving that maintaining bio-diversity can benefit the community and the project has trained 150 farmers to rear forest butterflies using tree leaves and the pupae are exported to Europe and North America with no adverse impact on the wild butterfly population. Kipepeo has since earned over $100,000 in foreign exchange for Kenya and has paid over $35,000 to farmers. A survey done in 1998 of the farmers, showed a major turnaround in attitude and over 84% wanted to preserve the forest (HUDCO-HSMI, 1999).

3.4.3 Environmental Aspects of Sustainable Shelter: This section will discuss the environmental aspects of sustainable shelter with respect to general comfort and areas likely to influence or provide additional means to comfort such as indoor thermal comfort, infrastructure services in shelter, energy use and its impacts, such as embodied energy and global warming.

Environmental Hypotheses *General comfort conditions are unsatisfactory in urban housing.*

Present Trends: As discussed in economic aspects of sustainable development, since independence, the main objective of planning has been economic development of the country. Former Prime Minister of India Mr Atal Behari Vajpayee, stated in the opening ministerial talk at the eight U.N. climate conference held in New Delhi that developing countries struggling to fight poverty and feed their countrymen produced only a fraction of green house gases and could not afford the extra emissions cuts. He told thousand of delegates from 185 member states of the U.N. climate change convention, gathered that developing countries did not have adequate resources to meet their human needs and our per capita incomes are only a small fraction of those in industrial countries and that climatic litigation would put a strain to the already fragile economy and would affect their efforts to achieve higher GDP growth rates to eradicate poverty speedily. He also added that at the World Summit on Sustainable Development held in Johannesburg in August 2002, it was recognised that poverty eradication, changing consumption and production patterns, protecting and managing natural resource base and economic and social development are

essential requirements of sustainable development (Shri Atal Bihari Vajpayee, 2002, www.meaindia.noc.in). The seventh five year plan for India postulated a growth rate of 5% G.D.P. and the eight five year plan a G.D.P. of 6% and the maximum growth was to be in the area of mining, manufacturing and the power sectors. These three sectors are also very exploitative in terms of resource use and degradation through deforestation, pollution and topsoil erosion and therefore unless more sustainable measures are adopted the development plans are going to have irrecoverable impacts on the environment (Buch N.M, 1991).

" We do not need to choose between a strong community and a high quality environment- we can have both "

RSPB, UK

Along with economic priorities, environmental sustainability is also becoming an important aspect of development planning which embodies the objectives of economic development, social equity and environmental soundness. Hence environmental management is an integral part of any sustainable development plan and therefore the fulfilment of basic needs and the alleviation go poverty should be planned within the boundaries set by the natural resource base (India: Environmental Priorities, 1991).

In areas of energy due to the increase in costs of different forms of energy, energy conservation is a viable means of cutting costs and promoting economic development especially in developing countries (www.teriin.org/energy/). Thus along with economic issues the environmental implications of urban development should also be recognised and addressed and integrated in the development plans, and priority given to the fundamental needs such as food and shelter of the urban and the rural poor. In the year 1972 Stockholm Conference marked the beginning of a concerted international effort towards conservation and environment protection and in India the first agency set up to solely tackle environmental issues was the National Committee on Environmental Planning and Coordination under the Department of Science and Technology. The Department of Environment was later set up in the year 1980 to serve as the main administrative structure of the government for planning, promotion and coordination of environmental programmes. This department has now gained the status of Ministry of Environment and Forest (India: Environmental Priorities, 1991).

In the area of shelter in order to overcome housing shortage, different agencies have made targets to build additional housing of over 2 million every year for the economically weaker

section and low- income groups. In this urgency to achieve the necessary objectives and targets, quantity supersedes quality and thus putting more pressure on the construction industry to embrace more economically viable and environmentally sustainable options.

In India, housing has always been given importance, though not enough when compared to the scale and nature of the shelter problem. Shelter should be an integral part of the overall development of the country, with particular regard for the poor. According to the official reports of 1984, over 100 million and 30 million urban people are shelterless, while the rate recommended by the U.N. for developing countries is 10 houses per 1000 population, in order to attain self-sufficiency in housing within a period of 10-15 year (Aromar Revi, 1992). In this urgency to achieve the objectives and targets to meet the demands of housing, different public agencies target to build over 2 million housing units every year for economically weaker section and low-income groups and often quantity supersedes quality and shown in figure 3.6 given below (Report by housing and urban development, 2000). Although the association of developers have to enter into a Memorandum of Understanding with the Institute of Architects to certify each project as meeting minimum specified norms, in most developments the quality of construction is not maintained. For instance although the Maharashtra Ownership Flat Act requires in the state of Maharashtra requires builders to give a two year defect –liability cover during which all repairs arising out of poor quality construction would have to be carried at the builders expense, it is never followed in practice (Deepak M. Satwalekar, Shelter, 1999).

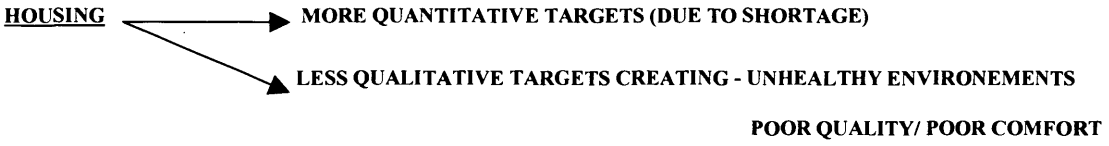


Figure 3.6

Comfort: is one of the things, which users expect from shelter. Comfort in buildings is dependent on a number of variables, which are to some extent common and to some can be subjective as well. Since there are many factors contributing towards the indoor temperature therefore human response is difficult to access in establishing design information for one particular variable (Croome Clements John Derec, 1997). Certain variables that contribute to the comfort and general well being of the inhabitants such as

density and space, indoor temperature with respect to thermal comfort and infrastructure services are discussed as follows.

Overcrowding due to lack of space is one of the common characteristics of poor quality rural and urban shelter in India, which affect privacy and the heat, and humidity of a space. Overcrowding can also extra pressure on public services resulting in inadequate supplies and overflows sewage systems resulting in environmental degradation. "Densities of about 8-10 metres square per person are generally regarded as being satisfactory" (Ward C. I, 2004). According to another source "Ideal standards prescribe a minimum cubic space of 8.5 cm (300 cft) for an adult and 5.67 cm (200 cft) for a child. For example in a family of five with three adults and two children and a room height of 3m, the minimum living space required for the family if 12.3m sq (130 sq.ft.) and anything less than this may be a health hazard" (K. Thomas. Poulose, 1988). Overcrowding and lack of ventilation also have impacts on an individual's health and well-being. "An environment that is toxic to its occupants cannot be considered "sustainable" and thus the considerations of "healthy buildings" are also considerations of sustainable design (Tony Rigg, Ruth Lahav).

One primary purpose of shelter is also to provide the inhabitants protection from severe weather conditions (Straciter Van J.F, 1967). However the day to day condition of indoor comfort are important aspects of comfort. Variables, which affect whether or not an individual feels thermally comfortable at any one time, are dependent on personal and environmental variable. Personal variables include clothing and degree of activity and environmental variables include air temperature, radiant temperature, air velocity and relative humidity (Cohen R Robert, 1997). However, with lightweight or very thin walled structures, there is little difference between indoor and outdoor temperature during summer or winter (Straciter Van J.F, 1967).

Human beings possess the capacity to adapt to a wide range of environmental changes and possess a temperature sensing hypothalamus gland acting as a thermostat with a set point 37 degrees centigrade. Comfort depends on the ability of the body to achieve a balance between energy production, heat gain and heat loss with a temperature maintained around 37 degrees centigrade. A difference on temperature initiates a chain of physiological responses to compensate for the rise and fall in body temperature. When the body reaches the limit and is unable to compensate, the body begins to feel either too hot or too cold (Basin News, 1999). The individual's comfort is not only dependent on temperature and humidity but also on the thermal property of the units, the clo value and the individual's

activity. According to one study, in North India the comfort range for light sedentary activity in summer is 69-76 degrees Fahrenheit, maximum shade temperature up to 115 degree Fahrenheit (46 degrees Centigrade). Summer of 81 degrees Fahrenheit to 83 degrees Fahrenheit (CET) was considered to be too hot and uncomfortable, 83 to 86 degrees Fahrenheit very hot and above 86 degrees Fahrenheit intolerably hot. According to literature only a small percentage can be expected to feel comfortable in an environment when effective temperature deviates by more than 6 degrees Fahrenheit CET (Correlated Effective Temperature) to either side of the optimum value. Beyond the threshold limit of absolute discomfort indirect effect on health such as fatigue, reduced working and mental efficiency are likely to occur. Lower income groups suffer considerable discomfort in winter as well, because of their inability to afford adequate clothing, extra blankets, good food and adequate heating (Straciter Van J.F, 1967). According to M.A. Humphreys, people use various approaches to achieve thermal comfort and that that they are not inert recipients of the environment, but interact with it to optimise their conditions. This ability to adapt is termed as Adaptive approach to thermal comfort. He states that "provided there are adequate possibilities for selection and adjustment, people will make themselves comfortable if they wish" and "discomfort is caused by excessive constraints being placed on those processes of choice and adjustment, rather than by the temperature itself, except in extreme conditions". Comfort is therefore seen as not only a physiological matter of heat regulation and clo values but also as an intelligent behavioural response to climate. Therefore according to Humphreys comfort temperatures are flexible rather than fixed and specified by climate and culture rather than physics and physiology (M.A. Humphreys, 1995).

In most parts of India excluding the Himalayas, the climate is often extreme, hot and dry or hot and humid. However the economic conditions in most developing countries is such that only passive means can be adopted by a large percent of the community in order to improve indoor conditions. According Z.N. Ahmed "this is unfortunate as the external temperatures in most of these areas during daytime is higher then that required for thermal neutrality for most of the year. He also adds that the need to adopt passive means as a result of economic constrains has imposed the standard of utilising the urban fabric to protect buildings from adverse effects of solar exposure and other climatic variables as well (Z.N. Ahmed, 1995). In order to make the indoor temperatures more comfortable, buildings often adopt the use of passive or active systems or a combination of both. Therefore traditional architecture of

most regions depends on passive shelter design like ample ventilation, thermal mass, central courtyards, vegetations and water bodies to keep the indoor more comfortable. Passive options like natural ventilation provide a comfortable thermal environment through natural circulation of air. Poor ventilation can lead to stuffiness and rise in humidity and temperature of a space causing the inhabitants discomfort. According to a study in a closed room each person exhales 0.6cft of carbon dioxide every hour and needs 3000cft of fresh air each hour which means that air change of 2 to 3 air changes in a living room and 4 to 6 in a workroom is recommended (www.msn.co.in). Windows serve the purpose by letting in fresh air and letting out stale air and in cross ventilation air moves from one opening to another as a result of difference in air pressures (Dr.Y.Etzion). Traditional buildings use passive systems like the use of screens carved out of stones with intricate punctured designs, which were designed to circulate air and were used more commonly in places that required privacy as well. In traditional buildings people also kept the indoors cool using passive systems like indoors water bodies for evaporative cooling and green internal courtyards. Another method more commonly used in hot dry places like Delhi are ventilators which work on the theory of convection, air flows from an area of high density to an area of low density as air rises when slightly heated and escapes from openings provided high up in the room and enters through inlets placed low and a narrow opening high up on the wall keeps the room cool in summers. Buildings with natural ventilation typically have lower running energy costs and lower capital costs as compared to mechanically conditioned buildings (Cohen R Robert, 1997). Along with natural ventilation, thermal mass was also used effectively in traditional architecture, for instance stones were used in traditional desert architecture of India which slowly absorbed the day heat and reached the indoors by night when the temperatures were much cooler. Cold collecting and storage element like the roof and structured materials in soil are an integral part of a building itself. Regular buildings collect heat during daytime and lose heat during nighttime due to loss of air by convection and radiant loss to the sky. However the average indoor temperature is always somewhat higher than outdoor even if house has shaded windows and has reflective or light colour walls- a result of some unavoidable solar energy absorption in the envelope. However the building is likely to have higher solar gains if the building is darker and internal heat generated by the occupants is more. For instance in one study when the roof of the building was coloured grey when the average maximum temperature was 31 degrees Centigrade and average external surface temperature was about

69 degrees Centigrade maximum ceiling temperature for 7cm thick wall was 45 degrees Centigrade, 12 cm wall was 39 degrees Centigrade and 20 cm thick wall was 33 degrees Centigrade. When the roof was painted white and maximum average temperature was about 27 degrees Centigrade and average external maximum surface temperature was 27.5 degrees Centigrade, the ceiling maximum temperatures were same for all the roofs that was around 25.5 degrees Centigrade. In the case of the walls as well, for the grey walls with white roof indoor temperature was above outdoor, while in the case of the white wall with white roof, temperatures were lower (Givoni Baruch, 1994). Thermal comfort may be defined as the sensation of complete well-being with the thermal environment and determined by human factors of activity and clothing and the environmental factors such as air temperature, air velocity and air humidity (Basin News, 1999).

Use of thermal insulation also reduce energy needs and hence energy used to improve thermal insulation (BRE, 1978). Energy use in building is important not only in terms of energy conservation, efficiency and pollution but also in terms of thermal comfort, the cost of energy and the percentage of the urban population who cannot afford energy costs (especially if fuel costs rise in future). Today most of the passive systems are being gradually replaced by mechanical systems like exhaust fans, centrifugal fans and air conditioners, which are more energy intensive and cost intensive, not affordable at current costs to a larger percentage of the urban population in India. A combination of passive and mechanical systems would reduce the energy costs like the use of natural ventilation and ceiling fans, without a compromise on comfort. There has been an increase in buildings in parts of the world that have some from of hybrid natural/mechanical ventilation systems recently (Jones J Phil, 1997). However a lot of energy still goes into making the interior environment of buildings comfortable often compensating for poor design (Basin News, 1999). According to M.A. Humphreys, ' Once the decision has been made to provide air-conditioning, the need for careful climatologically suitable and thermal design becomes less pressing. It is possible to build highly glazed lightweight structures in hot climates, and make them habitable by means of massive cooling with its consequent energy consumption" (M.A. Humphreys, 1995). Integrating passive planning systems like layout, orientation, thermal insulation, natural lighting and ventilation etc could help reduce unnecessary heat loss and gains. According to Prof Phil J Jones prediction of ventilation performance should be included at the concert design stage and at the detailed design stage to position and size openings and other ventilation devices (Jones J Phil, 1997). Natural

lighting is also an important factor that affects the quality of indoor space not only in terms of providing natural illumination. Natural lighting or more specifically daylight also reduces the use of artificial lighting and study shows that occupants prefer to work in day lit environment. Serious consideration must be given to use of day lighting, however solar energy can contribute to overheating especially unwelcome during summer. Apart from the use of adequate glazing, shading over windows in recommended. Designers in most developed countries use the assistance of sunpath diagrams and various programs in order to determine the appropriate size of the overhang (Ward. C. I, 2004).

Plants and trees have throughout the history of Architecture ornamented building and their gardens, however trees and vegetation have also been used to shade the building and reduce heat gains. According to a study by UCLA student Al Hemiddi (1991) trees with high canopies reduce heat gains and vines provide shading and insulation and lower air temperatures near the building skin reducing conductivity and infiltration heat gain. The use of plants and ground cover around buildings also reduce the reflected solar radiation and long wave radiation emitted towards the walls from surrounding area thus lowering solar and long wave heat gain in summer (Givoni Baruch, 1994).

In urban areas noise is another factor, which affects the inhabitants especially when the building relies on natural ventilation. There are two main sources of noise internal and external. The building can be protected from noise by means of a noise barrier such as fences or walls, earth mounds and other buildings by deflecting noise. In some cases trees are also used as barriers (Ward. C. I, 2004).

Infrastructure is another important aspect of shelter comfort. Infrastructure includes water supply, electricity supply, sewerage and drainage, sanitation, solid waste management, transportation, community centres, health and education. (HUDCO, 1998). Existing basic infrastructure services in terms of water supply, sewerage, sanitation, solid waste management, roads etc are not adequate especially for the poor sections of the community. At present only 10% of the land, finance and infrastructure services are available to the poor population of the capital city Delhi (Shashi Jain,1999). There is a lot of pressure on existing services hence increase in population is likely to put more pressure on existing infrastructure not designed to accommodate additional stress. This is likely to lead to the collapse of the systems infrastructure leading to problems like sewage overflows mixing with and water supply contaminating it, resulting in viruses and deceases and poor unhealthy environments for the inhabitants.

One of the essential service requirements of households is access to potable water. According to Development Alternative report almost one half of the population in South Asia lacks access to potable water and adequate sanitation facilities. Although demand for water supply in the domestic sector has remained low and accounts for only 5% of the annual freshwater withdrawals in India (World Resources Institute, 2000). But due to increases in population domestic water use will increase and recent data from the World Bank indicates that demand by 2025 will increase from 552 BCM to 1050 BCM that will require the use of all available water resources in the country. According to a survey carried out by Butler, WC, basin, sink, bath and washing machine frequency of uses/dwelling/day were found to increase directly in proportion to the number of occupants (Butler, 1993). Although demands will rise, the per capita availability of freshwater has dropped from over 5,000 cubic metres per year in 1947 to less than 2,000 cubic metres per year in 1997. By 2025 freshwater availability will further drop to 1,500 cubic metres per year and already six of India's twenty major river basins fall below the water scarcity threshold of 1,000 cubic metres per year, with five more basins to be added within the next three decades. Due to the poor quality of water from 0.5 to 1.5 million children under the age of five die yearly from diarrhoea in India and in Maharashtra state alone 0.7 million people suffer from water-related diseases (World Bank, 1999) (Development Alternatives, 2001). In rural India women are the principle users and collectors of water and therefore women bear the many costs associated with increasing water scarcity. Water is required for domestic use including various activates in the home for kitchen and sanitary needs (Wise et al, 1995). Water scarcity in many rural wares requires women and children to travel long distances to fetch water for household needs, which is not only physically strenuous but time consuming as well. According to one estimate women from semi-arid regions in India travel on average 1,400 km per year to fetch water from distant shores (Gupta et al. 1993). The time invested in fetching water could be used towards other income-generation activities or education programs.

Sanitation services and solid waste disposal services are not available to half the population in most urban areas like Delhi where waste dumps are overflowing there is a gap in solid waste disposal. With current lifestyles choices and trends, not only are we depleting our natural and non-renewable resources, but also continuously overburdening our environment with solid, liquid and gaseous waste. In terms of waste management even the best-managed cities of the developed world are having trouble responding to the increasing

population growth, failing to address the most fundamental issue of why that amount of waste is generated in the first place (TERI Newswire, 2000). This applies for the construction sectors as well where a lot of building materials, resources and energy are wasted during construction and also demolition. Waste during construction can be minimised if buildings use materials, which are flexible, recyclable (embodied energy content in recycled materials is much lesser than new materials) to different uses and users, and biodegradable, thus when a house reaches the end of its useful life it will not harm the environment. Waste by buildings come in many forms liquid, solid and gaseous. As mentioned before, the level of pollution is also rising in cites because of gasses contributed by transport systems, solid waste, untreated sewage and chemicals used by industries. Also the noise pollution at the household level is much higher than the prescribed limits (35 decibels for households and 50 decibels for work places). Due to limits to the expansion of cities, many industries have come within the city limits thus leakage of gases due to non-adherence of safety standards are very common (Harbans Singh Gill et al, 1999). In western countries failure to implement energy conserving measures is leading to excess of carbon waste in the environment and because it is invisible it is often ignored (Green Architecture, 1991). "Though the United States accounts of less than 5% of the worlds population, it contributes around 29% of the worlds ozone depleting CFC emissions. By comparison, China and India, accounting for around 20% of the worlds population, contribute 2%" (EarthWorks calendar, 1991, AIESEC). In terms of energy use as well " a citizen in an industrialised nation consumes in 6 month, the energy, and raw materials that have to last the citizen of a lesser developed nation his entire lifetime (Maurice F. Strong, Secretary General, United Nations Conference on Environmental and Development, Brazil, 1992, AIESEC). While the United States generates 160 million tons of garbage every year out of which 80% is put into landfills, 9% is burned and only 11% is recycled (Mr Schroeder, Waste Management International, at the Italy AGSS seminar, December 1989, AIESEC). Developing countries generate lesser waste as compared to developed countries and although developing countries currently only contribute to an estimated 20% towards greenhouse effect as they develop and industrialise this percentage will rise significantly and depicted in the figure 2.6 in the following page (AIESEC, 1990).

Figure 2.6

The management of waste will become even more important as the scarcity of materials is becoming more apparent and there is both ecological and economical loss if waste is not used as resource. Waste generated during every stage of the materials cycle should be considered for re-use, which includes the emissions, for instance many energy intensive industries release heat as a waste product which is not harnessed for beneficial uses. "In Japan, 'waste' refers to unusable materials which have no value. Those collected for recycling purposes are not defined as waste. Usually those recovered materials are called "Valuables" or "Recyclables" (WARMER Bulletin No.30, August 1991, AIESEC). Along with concern for waste generated from industries, focus must also be household waste, which can be viewed as small-undefined sources of waste, which on a collective scale generate significant amounts of waste. However in India despite present low waste generation as compared to developed countries it estimated that due to population growth and changing resource intensive lifestyles. Quantity of waste generation would increase to 8,763 MT in 2001, 13,676 MT by 2011 and 2021 AD and the inadequacy of the present waste disposal system has resulted in a gap of 44% in 2001, 59% in 2011 and 64% in 2021 AD. (Delhi, 1999). Even today the sanitation facilities in houses in many towns and cities are through dry systems latrines, which are services by manual scavengers who remove the human excreta. There are around 76 lakh (1 lakh=100,000) in over 3,655 towns with around 4 lakh manual scavengers, which can be stopped with the introduction of legislation approved by the Parliament and implementation of integrated low-cost sanitation schemes (HUDCO, 1998). "According to the 1991 census report 18.62% households do not have access to safe drinking water, 52% are without sanitation facilities and nearly half the households are not covered by solid waste disposal systems and data sources indicate that 70% of the illness reported to hospitals are due to unsafe drinking water and lack of sanitation services" (Harbans Singh Gill et al, 1999). Every year various parts of Delhi face water scarcity with a shortage of approximately 45% and is likely to increase 57% in 2021 AD and at present 48% of the sewage in untreated and discharged in raw form and the gap

is likely to increase to 59% in 2011 and 65% in 2021 AD (Delhi, 1999) "During the ninth plan, it was estimated that urban infrastructure alone would require Rupees 2,50,000 crore in the next ten years and only 10% of this would be available from Government sources" (S.P.Talwar, 1999).

"While wind energy and solar cell sales are soaring in some countries and bicycle production crosses 100 million in other countries, all these indicators point to a better future. All which India has yet to respond to and have to be supported by measures like policy shifts from fossil fuels, transportation and road systems that favour public transport and bicycles and make the policy shift in time" (R.Rajamani, 2003). Along with policy shifts, it is important that people are adequately informed about energy conserving techniques and best practices from countries with similar problems should be implemented. For example, issues like water supply in low-income areas can be addressed in a similar fashion to Tabata, a low-income neighbourhood, where the water supply system is being run and paid for by the residents themselves and the revenue generated is in turn helping to finance solid waste collection. This sense of community responsibility is helping ensure long-term sustainability of the programme (Ten Awardees, Shelter, 1999). "The surrounding issues, such as economic, politics and technology of development are secondary to the willingness of the people to alter their lifestyles and consumption patterns to a more sustainable model". An individual's knowledge of sustainable development can only be useful if the person receives proper information and is able to understand it. Education both formal and informal plays an important role in sustainable development by assisting people to make knowledgeable and value-oriented economic and political decisions, which can contribute to an improved quality of life. Although in most countries the governments should be encouraged to include the concept of sustainable development in their educational policies in the case of India the greater challenge is to increase access to education for all people (AIESEC, 1990).

Energy Use in Shelter: The energy equation of a building is made up of the embodied energy of the materials and the energy used in construction, maintenance and running the building. This section looks at these aspects of energy use in shelter along with the impacts associated with energy consumption.

Energy consumption, economic growth and population growth are all interconnected and in India it has been empirically proved that connectivity flows from economic growth to

energy consumption (Cheng 1999, www.teriin.org). According to a report by WWF, "meeting our energy demands currently requires the burning of fossil fuels (mainly) or nuclear energy (WWF, Environment Agency, Dec 2000). Energy is one of the main resources in shelter developments and essential for providing electricity for household use but it is often supplied at economic and environmental costs. In addition India's existing building standards do not consider the energy aspect (Basin News, 1999). Increased energy consumption is not only depleting the non-renewable resources but also polluting the atmosphere and in India total energy consumption has increased three-fold between 1970-71 and 1989-90, a large part of it being coal (India: Environmental Priorities, 1991). The construction industry can be major consumer and contributor to environmental pollution and a significant factor in the energy economy of India. Inefficient use of energy mostly in commercial buildings including most government buildings result in a financial loss of about Rupees 150 billion per year and energy wastage is around 20%. At present peak shortage is about 15% and base shortage is 10% (Ramesh Menon, www.teriin.org/power/). At present coal is the main source of energy, one of the most polluting of all the fossils fuels in terms of emission/unit of energy consumed, especially when fired in inefficient plants used all over the country. "Within the developing world- China, Brazil and India account for 45% of energy consumption compared to 50 countries of Africa that use less than 3% of the total energy consumption in the developing world" (The earthscan reader in sustainable development). The domestic energy consumption has risen since the past fifteen years as compared to the industry and the power supply position as on March 2001, which indicates a peak deficit of 13% and energy deficit of 7.8% at the all India level. The per capita electricity consumption of the country was 360Kwh during 1998-99 as against 334 in 1996-97 (Planning Commission, annual report, 2000-01). Although conservation and efficient use of energy has been given high priority by the government, in order to meet the growing demands of various forms of commercial energy, the model followed so far has been based on excessive consumption of conventional fossil fuels. The overall generation of power in the country has increased from 301 billion units during 1992-93 to 480 billion units during 1999-2000, against a target of 501.7 units (Annual Report 2000, Government of India). The following figures taken from various sources depict the energy demand of various regions in the world. Figure 3.8 in the following page show the regional shares in world primary energy demand, where current demands of the developing countries are

lower than the demands of the major industrialised countries. However by the 2030's the demands are likely to be more than the major industrialised countries.

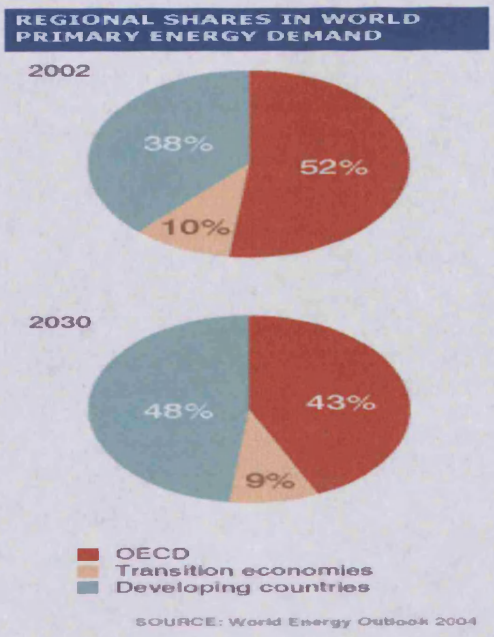


Figure 3.8

Figure 3.9 given below shows the rise in CO2 in industrialised and developing countries, where by the 2030's developing countries exceed carbon emissions.

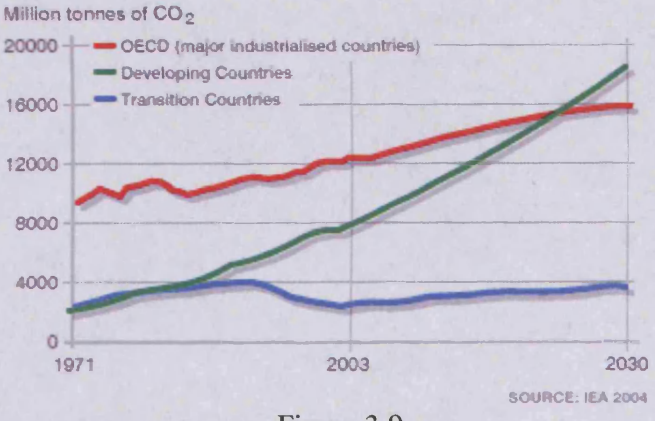


Figure 3.9

Current development path followed by Government bodies need to be changed. Architects and builders should do their part by reducing energy consumption by using low energy, natural and local materials and reduce the use of manufactured energy consuming materials like brick, cement and steel wherever possible. According to UNCHS Habitat report on

energy for buildings aluminium is a very high energy material, steel and cement are very high energy materials and concrete and clay bricks are medium energy materials and these are commonly used materials in construction in India. While material like fly ash are low energy materials (www.asianscholarship.org). Therefore not only are the materials used not cost-effective they are energy intensive as well hence builder should opt for alternative and cost-effective building materials and technologies available. Architects and builder should also aim to reduce heating and cooling load by using solar passive techniques, such as proper orientation of buildings, sun shading of windows etc and avoid wastage of energy while building is in use by providing day lighting and energy efficient equipment for all uses in the building (Teri, 2000). The properties of the building materials used also affect the energy use and running expenditures of the building for instance, one way is to reduce thermal insulation and cavity wall dwelling on an average have slightly better u-value than solid walled dwelling (BRE, 1978). Construction of buildings should not create large amount of waste and should be designed with prior regard for re-use and recyclability of their materials and components, as embodied energy in recycled materials is less.

The production of certain materials like cement (which is basically non-recyclable) and aluminium (which is recyclable) are very energy intensive. The construction sector is responsible for a large percent of all India's CO2 emissions and the major energy users in the building materials industry are the producers of cement and steel (Ministry of Coal, 2003, www.teriin.org). At present coal dominates the Indian energy scenario due to its abundant indigenous availability and about 70% of the coal produced is consumed by the power sector. In the year 2001 coal contributed to almost 55% of the primary fuel demand and oil contributed to 34% (International Energy Agency 2002,TERI). The production of coal in 1990-91 was 211.73 MT and other sources like crude oil was only 32.03 MT, the anticipated production of coal in 2001-02 was 325.65 MT and crude oil was 32.03 MT (Planning Commission 2002, TERI).

Embodied Energy: The embodied energy in buildings is the energy consumed by all the processes associated with the production of a building, from excavation of the natural resources, manufacture of materials and the equipment to the product delivery. "The assessment includes the entire life cycle of the product, process or activity, encompassing, extracting and processing raw materials; manufacturing, transportation and distribution; use, re-use, maintenance; recycling, and final disposal" (Guidelines for Life-Cycle Assessment: A 'Code of Practice', SETAC, Brussels, 1993).

Maintenance also adds to the embodied energy over a building's lifespan hence one of the important factors in reducing the impact of embodied energy is to design durable buildings. Today most buildings only concentrate on the operational energy. While operational energy consumption is dependent on the occupants and can be influenced throughout the life of the building, embodied energy is dependent mainly on the builders, planners and the materials they use. Research by CSIRO has found that the average household contains about 1,000 GJ of energy embodied in the materials used in its construction. This is equivalent to about 15 years of operational energy use. Hence for a house that lasts 100 years this is over 10% of the energy used in its life.

Embodied energy can be calculated by using the process of life cycle assessment (LCA) which looks at the material from extraction and processing, through the operating life to end use (disposal or recycling) and considers a range of environmental impacts such as resource depletion, energy use, water use, greenhouse emissions and waste generation. An internationally agreed standard (ISO 14040) defines standard LCA methodologies and protocols. "Life-cycle analysis can also be used for acquiring information for process management and developing more environmentally friendly products. Life cycle assessment is a systematic set of procedures for compiling and examining the inputs and outputs of materials and energy and the associated environmental impacts directly attributable to the functioning of a product or service system throughout its life cycle" (ISO 14040: Life cycle assessment – principles and framework, 1998). Different stages are accurately charted and for each stage an inventory is made of the energy consumption and of the emission into the environment making it possible to identify processes or points where improvement can be achieved and often results in economic advantages as less material and less energy are used or less waste occurs (www.lca.org).

Global Warming: As a result of global population increase, resource intensive lifestyles and heavy dependence on non-renewable resources have combined to place immense pressure on earths resources and uncontrolled, hasty development has brought the world face to face with an environmental crises of immense proportion (UNCED earth summit in Rio, June 1992, gave official recognition to this, when the governments of the world unanimously agreed that this was the major priority of universal concern for the coming decades). The expected rapid increase of the world's population in the coming years and

rising standards of living would create immense pressure on the environment if the reliance were to remain on the existing technologies, consumption habits and resources.

According to the world ecological footprint measure by the WWF (World Wildlife Fund), humanity's use of renewable resources grew by 80% between 1961-1999 to a level 20% above the earth's biological capacity (www.panda.org).

People not only rely on the earth's resources for food, materials, and water but also to absorb carbon dioxide and rapid consumption is putting the world user under the threat of global warming. " Scientists will tell you that they are not sure yet whether carbon dioxide and methane in the atmosphere are leading to global warming. But most people will agree the evidence is strong enough not to take the risk that is untrue." (Clem Sunter, Director, Anglo American, at the South African AGSS conference, December 1989, AIESEC, 1990)

Global warming is caused by the build-up of green house gases like CO2, water vapour, methane, chlorofluorocarbons (CFC's), nitrous oxide and ozone, which trap energy on the surface of earth and although the presence of green house gases is essential for survival of all living beings, any increases disturb the natural balance. " There is now a significant amount of scientific evidence to acknowledge that these gases cause global warming and much of the debate is now on to what degree there will be global warming" and waiting for further proof may be too late to treat the situation (AIESEC, 1990). According to one report there has been an increase in CO2 from 270 parts per million (ppm) to 350 ppm, a rise of 1/3 rd in 200 years (Nature Conservancy Council, 1990). Most of the increase in greenhouse gases comes from anthropogenic activities like burning fossil fuels for energy generation, which release CO2, and climate change can occur with a doubling or halving of atmospheric C02 concentration. It is thought that over the next 100 years CO2 (mainly fossil fuel burning) will be responsible for 63% of future warming, methane 24%, NO 10% and other gases 3% (Country Land and Business Association, 2001). A sizeable contribution also comes from deforestation accompanied by clearance of land for agriculture and from CFC's used for coolants, propellants and solvents. In developing countries the main activities responsible for change in green house gases are mainly due to changes in land use such as deforestation and clearance for agriculture land, while the developed world is largely responsible for most of the production of CO2 and CFC's (www.panda.org). Although deforestation and methane production from rice fields in developing countries contribute to greenhouse effect, according to a report on Global Warming by Centre for Science and Environment, New Delhi, the accumulation is mainly

due to the gargantuan consumption of fossil fuels in developed countries, particularly United States (India: Environmental Priority, 1991) At present only 0.03% of the atmosphere is CO2, which relates to approximately 6 giga tonnes of CO2 emission per year. Atmospheric carbon dioxide concentration has increased from about 280 ppm to 360 ppm since the time of the industrial revolution (1750 AD). CO2 emissions from India are estimated to be 1,001,352 Gg, which is around 3% of the total global CO2 emissions. In the year 1990, the per capita emissions for Japan and the US were 2400 and 5400 kg of carbon and India was 325 kg (www.teriin.org/climate/). According to one report US CO2 emissions per/person/year is around 500 and UK 250 when rest of the world average is 100 (WWW, Environment Agency, 2000). India and China only produce 2% of the responsible chemicals "Nevertheless, it is certainly incumbent on a country like India to take action to minimise its contribution to the production of greenhouse gases by introducing energy efficient technologies to the extent possible and by maximising the sinks of carbon dioxide through afforestation and other biomass production" (India: Environmental Priority, 1991). The build-up of greenhouse gases is also expected to raise the earth's temperature by 2.5 degrees centigrade by the year 2010 AD. (India: Environmental Priority, 1991). According to records since the beginning of the 20th century the average temperature of the globe has risen by 0.6 degrees centigrade. Temperature rise in the 20th century is likely to be the highest during any century since, 1000 AD. "There is now convincing evidence that temperature rise over 50 years is mainly due to human as activities such as burning fossil fuels" (UK Climate Impacts Program, July 2003). In the 20th century forest cover and ice extent have also decreased, sea levels have raised along with rise temperatures (Climate Change and the Rural Economy, 2001). Climate change affect social, economic and environmental well-being of a community and hence a key influence in present and future developments. For instance hotter drier summers would put more pressure on water resources and temperature increase would affect thermal comfort (Plantlife, June 2005) Hence it is important for policy makers, industries, engineers and communities to be well informed and to adopt efficient options. According to measurement records by Intergovernmental Panel on Climate Change suggest that the world has already warmed by 0.3 to0.6 degrees Centigrade since 1860 and the last two decades have been the warmest, and that the present warming is anthropogenically induced. And the average surface temperature from1990 –2000 is predicted to increase by 1.4 to 5.8 degrees Centigrade (www.teriin.org/climatechange). According to the climate change scenarios for the United

Kingdom summary report, fossil fuels were the main contributors to the 20th century temperature rise of 0.5 degrees, along with decreasing number of cold days and increasing number of hot days (UK Climatic Impacts Program Technical Report, Mike Hulme & Geoff Jenkins, 1998).

India is among the top ten contributors to greenhouse gas emissions but per capita gross emissions are only one-sixths of the worlds average (www.teriin.org/climate/) Shelter activities also contribute to ozone depletion mainly caused by CFC's emitted by building air conditioners and the process used to manufacture building materials. Around 25% of the total energy demands of the nations are due to manufacturing materials for buildings and 30% go into the running needs of the building (Teri Newswire, 2000).

At present scientists have measured a significant rise in the levels of heat absorbing gases in the atmosphere and these increases have given rise to global warming which can result in damaging consequences for the environment. According to scientists from CGAM (Centre for Global Atmospheric Modelling), Reading University, extreme weather changes are having increasing financial and human consequences and 2004 has been the most expensive year globally for insurance industry in payouts for damage from hurricanes and typhoons. The US estimated $90 billion of damage caused by natural disasters in 2004 and Japan experienced the highest number of tropical storms on record. Human lives lost has also been high the Caribbean island of Haiti alone, experienced 3000 deaths caused by Hurricane Jeanne in September 2004 (www.extra.rdg.ac.uk).

According to one study, possible impacts of climate change are extreme heat and thus increase in energy consumption for air-conditioning and losses in hydropower availability that will have consequential social and environmental effects (Linder. K & H. Ingles, Potential Impacts of Climate Change on Electric Utilities, Regional & National Report of ICF to the US Environment Protection Agency, 1988). Therefore United Nations framework convention on climate change aims at stabilisation of CO2 emissions (www.teriin.org/climate/).

" It is predicted that these factors will cause climatic changes result in the melting of polar ice (leading to rise in sea level and subsequent flooding) desertification, and the disruption of ecosystems to name a few" (AIESEC, 1990). Global warming of several degrees within the next 50 1o 100 years could also result in the sea level rise of 0.5 to 1.5 metres and could eventually break up the west Antarctic ice shield and lead to a sea level rise of several metres. Although even a modest sea level rise would upset the coastal settlements all over

the globe (www.iisd.org/climate/). According to global impacts scenarios from climate change in the 2080's sea levels are likely to rise by 2.2 mm/year in UK coasts (DETR, 1999). In the proceedings of Indian Academy of Sciences, Indian tide gauge records Das and Radhakrishna have reported an increase in sea level in five coastal locations of India with trends that appear to be higher in the eastern coast as compared to the western coast (Das and Radhakrisha 1991, 1993, Earth and Planetary Sciences, www.teriin.org). According to some future global impacts scenarios from climate change in the 2080's India is likely to be one of the stressed country to develop increased stress with respect to water stress. Also the total number of people flooded along coastline in India and Bangladesh are likely to be in millions (Source: The Met Office & DETR 1999 & Middlesex University, Environment Agency, Dec 2000).

Developed countries the highest contributors of CO2 emissions and waste generators but developing countries are likely to be most affected. For instance, bulk of the plastic waste and other form of industrial waste from developed countries is exported to developing countries and one of them is India. Climate change could result in additional stress on ecological and socio-economic systems that are already facing a lot of pressure particularly the low-income sectors as a result of rapid urbanisation, industrialisation and economic development (TERI). Climate change will so affect the low-lying densely populated coastline which extends about 7500km and UNEP (1989) identifies India as one of the 27 countries that are likely to be most affected due to sea level rise as most of the coastal areas are agriculturally fertile but highly vulnerable to inundation and salinization. In the absence of protection one-metre rise in sea level would flood 1700 km square of prime agricultural coastal land of Orrisa and West Bengal (IPCC, 1992). Coastal infrastructure, tourism and onshore oil exploration are also likely to be affected, having not only ecological and socio-economic implications but also putting millions of people at risk (TERI). In India the frequency and intensity of floods have increased and the annual flood losses have increased 15 times. On an average flood affect an area of 9 million hectares every year and the average area prone to floods has tripled since 1960 from 19 to 59 million hectares (India: Environmental Priorities, 1991). According to an OXFAM report, floods are now an annual feature especially flash floods mainly as a result of devastation of forests in the catchments leading to heavy soil erosion and increased utilisation of flood plains for agriculture and urbanization has increased the damage over the year. Therefore activities like deforestation in the Himalayan foothills are already affecting the occurrence of floods in India especially

in the Ganga and Brahmaputra basins (India: Environmental Priorities, 1991). Rise in sea levels will have a greater impact on low-lying countries like Bangladesh (R.Rajamani, 2003).

Global warming is also likely to affect shelter comfort as temperatures rise in future. Rapid urbanisation and rising resource intensive lifestyles will increase use of mechanical systems. But a larger percentage of the population which are the low-income and the economically weaker sector are likely to suffer the most as a result of external element like global warming since they lack the funds and resources to adapt to the environmental changes.

3.4.4 Political Aspects of Sustainable Shelter: This section will discuss the political aspects of shelter by looking at the trends in Government policies, their implementation and impacts on urban shelter

Political Hypotheses *Housing policies and programs are based on based on public body understanding of user needs and not on real user inputs.*

Past Trends in Government Policies during the last 9 Five Year Plans: Policies play an important role in the direction of development the country takes. Therefore before long-term strategies and policies are prepared, it is important that the issues are understood and placed in their proper perspective (India: Environmental Priority, 1991) In addition "Policies must improve a community's standard of living to have some chance of addressing populations problems" (AIESEC, 1990).

"In India, from the first five year plan, housing has been given importance though not adequate as compared to the magnitude and nature of the problem and the rate of construction of houses in the country has been as low as 2.5 to 3 per thousand population while the rate suggested by the U.N for developing countries are 10 houses per thousand population in order to attain self sufficiency in housing within a reasonable period of 10 to 15 years" (K.Thomas Poulose, 1988). "Government estimates claim cumulative construction backlog of over 18 million rural and 6 million urban houses" a housing gap which is increasing every year and yet "the relative allocation to housing has not changed much during the 35 years of planned development, being generally maintained between 1.2

per cent and 1.3 per cent of the total plan budget" (Aromar Revi, 1990). The policies for urban development and housing in India changed every five years with emphasis shifting from institution buildings to houses for the economically weaker section, from slum removal to slum up gradation but a growing number of the population still lack of basic housing and basic services. According to the five year plan documents of 1978, the priority given to shelter has decreased from 1.96% in the first five year plan to 1.36% in the seventh five year plan (Bose 1978;NBO 1983;Five Year Plan Documents, Aromar Revi, 1990). The Government policies in the five-year plans have been discussed briefly below.

In the First few Five Year Plans starting from 1951 emphasised on institution building and on construction of houses for Government employees and weaker sections and rehabilitation of the refugees from Pakistan and on building the new city of Chandigarh. Main focus was on development of irrigation industry and agriculture and housing was given low priority of 1.9% of the total budget. Also people's participation in the shelter construction was limited and designs adopted were inflexible and not targeted for the poor. The main issue affecting shelter during the earlier policy phases was technology and availability of modern building materials and therefore investments were made on modernization and increased production capacity of cement and steel was promoted which were beyond the means of a larger section of the population.

Slum Clearance was also introduced during the early five-year plans. During the late sixties investment in shelter activated further reduced 1.2% of the total budget and priority to given rural housing went down from 11.5% to 3.5%, while slum development expenditure rose. In the late seventies during the fourth and fifth year plans, which were also the years of the energy crisis, focus was shifted to poverty alleviation, rural development and increased national initiatives on shelter with an increase in housing budget to 1.25%. Although slum development outlays dropped from 31 to 16%, and R&D decreased further to 0.1 of the total shelter budget. Slums were accepted as part of a community and policy shift was made from slum relocation to in-site up gradation and the absence of user participation in shelter was recognised. During this phase agencies for environment, energy and pollution control was also set up. During the eighties rapid economic growth was significant with an increase in shelter activity in rural areas from the year 1980-85, the rural budget for shelter doubling from 11.1% to 27.2%, but the R&D budget reduced to less than 0.15% of the total housing budget. Focus was directed towards greater public participation

and promotion of self-reliance among the poor with recognition of the need to shift benefits of the housing programme from the formal sector to the economically weaker sections and an urban poverty alleviation scheme known as Urban Basic Services to provide housing for all, improve housing conditions of the inadequately housed and provide a minimum level of basic services and amenities to all was launched. But the importance given to research, technology, materials and information system remained low (Aromar Revi, 1990) (Buch.N.M, 1991).

The National Commission of Urbanisation report of (1992-97) recognised rapid growth of the urban population as well as rapid urbanisation, the critical deficiencies in infrastructure, the acute disparities in the access of shelter and basic services among the poor, deteriorating environmental quality and the impact of poor governance on the income and the productivity of enterprises. According to the annual report of 1999-2000, the reasons for low performance of housing schemes are inadequate budget provision, land acquisition problem, difficulty in providing services, institutional capability, lack of access to institutional finance, shortage of materials, rising costs of construction, etc.

In 1998 the National Housing and Habitat Policy was formulated in order to address issues of sustainable development, infrastructure and strong private public private partnership (Annual Report, 2000-2001). The policies were created with the objective of creating surpluses of housing stock and facilitate the construction of 2 million additional dwelling units along with supporting services each year in partnership with private bodies. Also the Government would provide fiscal concessions and carry out legal and regulatory reforms and address the problem of housing shortage. The National Agenda for Governance identified Housing for all as a priority area with emphasis on the needs of the more vulnerable groups. This program proposed construction of 20 lakh (100000=1lakh) additional units every year in rural and urban areas with emphasis on economically weaker sections and the low-income groups and the policy focus shifting from built housing to infrastructure development in slums by providing basic services and house sites. The National Network of Building Centres were established under a central scheme to impart training to artisans in low cost construction skills and produce building materials and components by using agro-industrial wastes. These centres function with the aid of Government loans and have imparted training to over 1.40 (100000=1lakh) lakh

construction workers (Annual Report, 1999-2000) and play a crucial catalytic role in transferring sustainable building technology packages to rural micro-enterprises.

Despite all the government action over the years government programs have not been able to close the housing gap and improve shelter conditions, and shown in the figures 3.10, 3.11, 3.12. The figure 3.10 shows that there was a gap of 17000 between the target and the number achieved in the year 1998 –1999, and a gap of 2000 between the target and the numbers achieved in the years 1999-2000 for the low income group dwelling, although the target set went down in the year1999-2000 and thus do not account for a large addition of housing every year. The same case is in the dwelling units for the economically weaker section in figure 3.11 targets and achievements have went down and in the case of environmental improvement of urban slums in figure 3.12 although the targets went up the achievements were very low (Annual Report, 1999-2000). Even in the case of state Government performances in housing in the year 1999-2000 for example the housing for the economically weaker section or the low-income group, many states have made targets for houses with zero achievement while some states have made zero targets as well (Annual Report, 1999-2000).

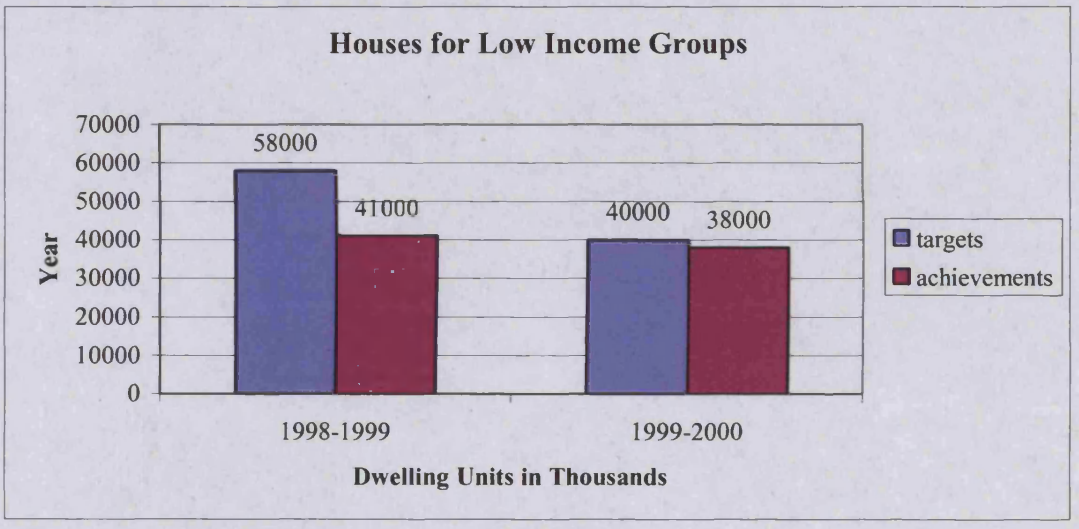


Figure 3.10

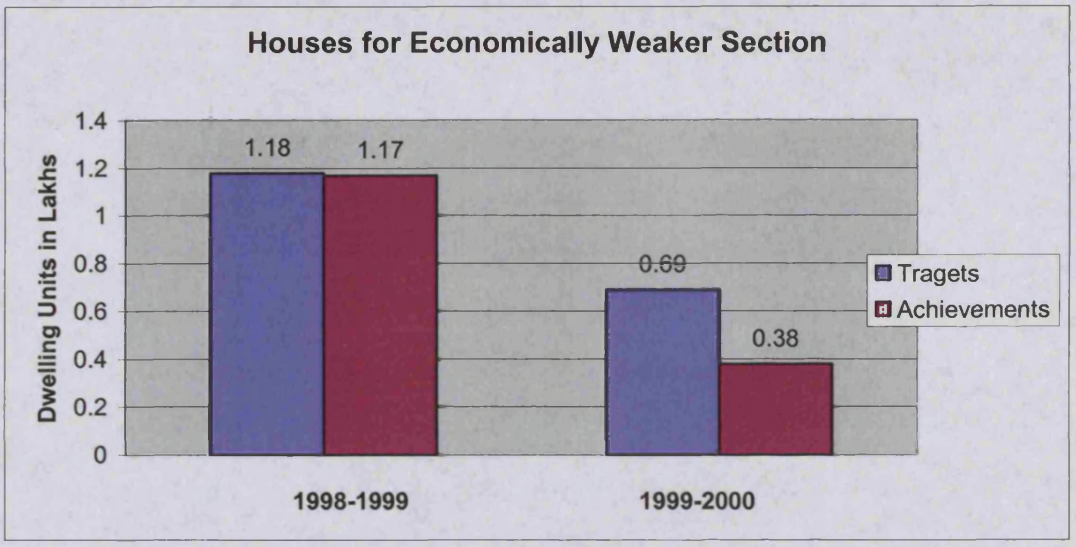


Figure 3.11

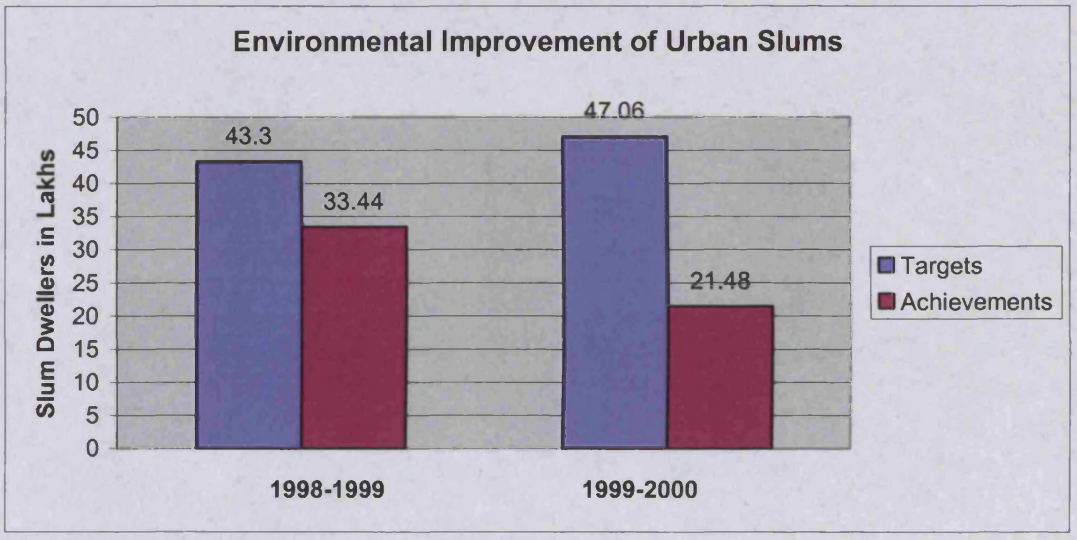


Figure 3.12

In order to deal with the housing problems not only do policies need to be developed and implemented but there is also a need to understand why the policies fail -to deal with the problem they have been developed to address. The reason for this could be attributed to lack of democracy – in some cases where governments only represent the interests of those with access to power and with unequal access to power some sectors of the society are neglected and accordingly not fully informed. Therefore the policies formulated are based on inadequate information and incorrect diagnoses of society's' problem, which often leads to unsustainable development. For instance the Urban Land Ceiling Act regulated in 1976

failed to achieve the objectives for which it was first formulated. "The act was aimed at socialising all land in excess of a given quantum on payment of a nominal amount, thus making available large chunks of strategically located land for use by the common man" (Buch.N.M, 11991). However instead of making land available for building houses for the poor, it locked large tracts of land in litigation. Furthermore abolishing the ULCR Act would increase the number of houses benefiting all, in particular the poor (Shri Atal Bihari Vajpayee, Shelter, 1999). The shelter policies formulated are also not always goal specific nor do they formulate strategies in clear terms. For instance, "The first plan document states "Private enterprise has proved incapable of meeting the needs of housing and the state has to assume direct initiative a and responsibility in this field to an increasing extent." This statement is not a declaration of policy, but only a tautological repletion of facts" Another example is the sixth plan document which states that "house construction is an economic activity which fits in with the pattern of activities to which priority will be given in the next two decades, not only because it meets a basic need, but, gives the application of appropriate technologies, also creates employment in a massive decentralised scale and increases the much needed purchasing power in the hands of lower income groups." Hence as indicators of policy these statements make no rational sense (Buch.N.M, 1991).

Another factor can be the lack of accountability in public sector institutions often manifesting itself in the public sectors' non-disclosure of information, which result in irresponsible policies and disregard the issue of representative participatory government. Over centralization is another aspect, which can lesson the participation of the people. As discussed in the economic sections most of the government programs are run with short-term objectives of development and economic growth. Government in the country can change according to the political situation in the country, which can result in the lack of continuity and unsustainable short-term policies. Also the division of issues and agencies within the public sector like different ministries for environment, health and shelter often result in polices based on outdated concepts, which lack joint effort and coordination between the bodies, NGOs and other experts leading to policies which lack long-term benefits to society as a whole (AIESEC India, 1990). With the assistance and implementation of long- range urban shelter policy conceived in a wider perspective of the country's economic development, urbanisation and natural resource management the future will be full of possibilities for administrators, investors, planners, builders, industrialists, economists, ecologists and above all millions of urban dwellers of India. Housing

development can be improved by changing the shape, size, residential density, layout, and location of activities in cities can bring energy demand variation to a high percent, community participation in planning and construction, use of alternative building materials and technology can reduce level of energy consumption (TERIvision, 2000).

"One basic drawback of our systems of planned development is the lack of continuity and progressive improvement of policies and strategies" and " in many instances, policies change along with the change of personnel and in not too rare cases the last mistakes are repeated and good features ignored". People in developing countries under democratic systems have developed a culture of letting the Government solve all their problems and not taking the responsibilities to solve their problems themselves. (K.Thomas Poulose, 1988). Policy options continue to be controlled by socio-cultural behaviour patterns and vested interests (India: Environmental Priority, 1991). Politicians have a lot of influence on local, national and international strategies towards sustainable development and hence people, youth in particular should make an effort to obtain information on their candidates approach to local, national and international environmental issues and take this consideration when voting. This will in turn force the politicians to react to and address peoples' environmental concerns (AIESEC, 1990). Also NGO's and environmental groups have better access at the grassroots level and hence good relationship and interaction between environmental and NGO groups, media, and the parliament. This relationship can enable groups to raise issues for Government attention and ensure considerable support against for any official policy, which are likely to have damaging consequences. Government and Ngo's also need to work together since the limiting factor for such organisations is money, which limits lobbying. Also a well-informed and technically competent pressure group or organisation can keep the MP well briefed and if very competent the group is likely to be drawn into consultation over relevant issues. Close contact with the Government departments can also help the groups gather advance information, which is essential to develop their criticism of the course of official policy (Goyder Philip, 1983)

According to People First, an organisation invited by the Earth Council to organize Earth Charter Process for India, preliminary consultations organised with resource persons on the issues of planning and environment resulted in the identification of four basic principles for human settlement planning that are essential for the sustainable management of the

settlements and they are- self governance, land ownership, planning with nature and appropriate technology.

One of the obvious reasons for the unsuccessful nature of the programmes is that most of the policies developed remain largely unimplemented. According to WWF publication on the living planet, in order to protect and sustain the earth productive capacity we have to eliminate the use of toxic chemicals that degrade the ecosystems functioning and as far as possible substitute them despite these guidelines in the industrial sector uses toxic waste are being used for products which have been banned by the Government and in certain cases even imports toxic wastes from developed countries, an example of this is a hazardous fertiliser waste material called phosphogypsum being used in the construction industry in gypsum plaster, gypsum ceiling tiles, boards, panels and marble blocks. It has been listed as a hazardous waste under act 16 of the hazardous wastes handling and management rules 1989 framed by the Government of India, and still being promoted for use in building construction. Materials made of phosphogypsum were also exempted from excise duty in the years 1992-92 (Nidhi Janwal, Down to Earth, Jan 13 2000). Phosphogypsum is a by-product of fertilizer industry waste, contains radium, which decays to radium gas and has been classified as a human carcinogen by WHO and EPA.

3.4.5 Technological Aspects of Sustainable Shelter: This section will discuss the present trends of technology and material use in shelter.

Technological Hypotheses *Despite efficient alternative building material options present choices adopted are not cost, resource and energy efficient.*

Present Aspects: Developing countries often lack the funds and the technology to industrialise without heavy dependence on fossil fuels and other disruptive products and production processes (AIESEC, 1990). Construction industries are a major contributor to both economic growth and environmental degradation and thus important aspects of sustainable development. The construction industry not only provides shelter but also infrastructure in the form of roads, buildings and factories. In India's national plans, construction sector constitutes 40-45% of the capital expenditure on various segments of infrastructure such as power, transport, communication, urban and rural housing etc (Annual Report, 2000-01). Population growth will require a significant increase in the

supply of houses and therefore easy access to affordable and user friendly building materials. Conventional building materials like burnt bricks, steel and cement are high in cost, utilize large amount of non-renewable natural resources like energy and minerals (HUDCO, 1997). Resulting in high construction costs at scale much higher than inflation and therefore beyond the reach of the majority of the people. Also reducing the size in housing for various categories in respect of the plinth area and nature of specification despite increased income levels are fair indicators of increase in construction, where in less than two decades construction costs have gone up from around Rupees 1000/-per sq.mt to around Rupees 4000/-per sq.mt. And for better finishing and other amenities the costs can come up to around Rupees 5000/-to 7000/-per sq.mt (HUDCO, 1997).

Building codes in India promote the use of energy intensive materials like reinforced concrete, steel and aluminium. In addition the use of steel, aluminium and plastics have increased since the banning of timber. These materials have high-embodied energy, are resource depleting and environmentally degrading (Basin News, 1999). But options like use of bamboo substitutes and plantation timber have not been adopted. Technology choices adopted by a county can have a critical impact on many aspects of sustainable development also both private and public sectors and companies have stepped up investments in plants and machinery more than in labour intensive industries. Therefore not only are the industry choices affecting the environmental but social-economic aspects as well. As employment generates income, which satisfies the need for food, housing and health, increasing the opportunities for employment should be a priority for governments around the world (AIESEC, 1990). Hence the construction sector should also contribute towards employment generation and promote local economies. However, the construction industry has also been a major contributor of pollution and a major source of environmental damage through depletion of the natural resource base, degradation of fragile eco-zones, chemical pollution and the use of building materials harmful to human health (www.panda.org). The materials that are used to build our home can have significant health and environmental effects, often extending far beyond the specific context of their end use as in the case of phosphogypsum, which is a hazardous waste and is being by the building construction industry (Nidhi Janwal, Down to Earth, Jan 13 2000). The materials and technology chosen for construction, in addition to functional efficiency, must for the cause of sustainability and better quality environment not endanger bio-reserves, be non-polluting, be self-sustaining,

be recyclable and promote self-reliance by using locally available materials and skills as well concentrate on supporting local research and development capacity (India: Environmental Priorities, 1991).

Adoption of sustainable and efficient building materials and technologies could aid in million houses being built and hundreds of thousands of jobs being created without destroying the environment. (Development Alternative, 1986). Also unlike political and institutional constraints, technological constraints are relatively easier to handle and hence the research and development capacities for developing technologies appropriate to the Indian needs should be greatly strengthened, particularly among the private sector. However due to financial constraint the facilitation of new technologies and institutions is difficult and requiring larger flow of international financial assistance. Although international assistance is only a small part of the total input to national development projects, it can be significant in its impact, because it can be more focussed, more free of political constraints and can be used more innovatively. Most of technology transfer from developed countries have proved to be inappropriate in the Indian Context hence international assistance should be directed to activities that support innovative approaches to programme and project formulation and execution. Since awareness generation and education are fundamental in order to transcend the thematic environmental priority issues, the programmes should aim to attempt innovative and traditional techniques of communication which include street plays, puppet shows, local folk songs, etc. (India: Environmental Priorities, 1991).

"Inefficiency is a problem because it unnecessarily uses up excessive amounts of scarce resources" and " the present manner in which energy needs are satisfied leads over consumption and wastefulness" (AIESEC, 1990). Hence efficiency should be given priority to at every level of the material flow cycle, which comprises extraction, product manufacture, and product use, where the outflows from one process provide the raw materials for another process. This can be achieved by adopting options such as improvements on product design, environmental technology, use patterns and waste management as described in the figure 3.13 in the following page (Vidya S Barta, www.teriin.org).

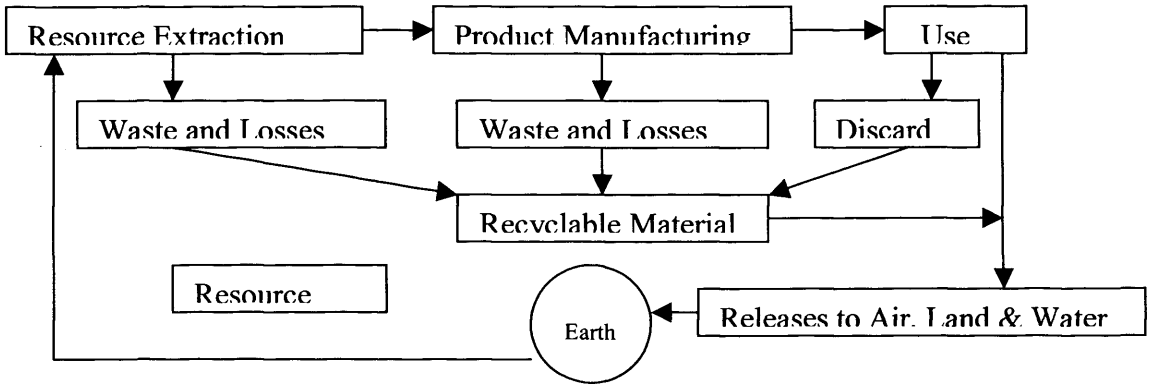


Figure 3.13

The availability of building materials is a major constraint in the Indian housing scenario. "In the city of Delhi alone, if 80,000 new housing units are to be constructed every year, the requirement of bricks alone would be approximately 1.1 billion and of cement about 600,000 M.T., wood about a thousand cubic metres and reinforcement materials of about a hundred thousand metric tons per year. The capacity of the brick kilns around Delhi is only 140 million bricks per annum, and this has almost never been achieved. In any case quarrying areas are now nearly exhausted, not only in Delhi, but around most major cities and towns in the country"(Buch.N.M, 1991). Hence alternative technologies and recycled materials will have to be more widely applied in order to deal with the housing crises, these options are environmentally sound as well.

Also due to the shortage of shelter and the rising cost of construction, it has become very essential to adopt appropriate and cost effective building materials and technologies, which are structurally, functionally and socially acceptable as well as it will be within the affordability levels of the people. There are many cost effective materials and technologies developed by various R&D bodies including the works of Laurie Baker but their applicability has been limited to only a small number (K.Thomas Poulose, 1988).

At present a lot of research is being done on finding alternative materials and means of disseminating these products and the knowledge that goes with it to the users. Although a lot of work has been done in the past to introduce new building technologies and materials in the construction sector in the rural as well as urban areas of India, most of these technologies have remained within the confines of the laboratory and have failed to achieve

any user level applications which may be attributed to absence of dissemination of knowledge and know-how (HUDCO, 1997). Hence a large number of people and organisations have been trying to find methods of helping people in improving their habitat and focusing on the use of locally available materials through promotion of alternative and efficient building technology and providing the expertise through trained professionals. However they lack the workability as they have not reached the local manufacturers and involve local builder (Development Alternatives, 1986).

Although in urban areas new technologies and conventional materials are adopted, in rural area the house owner and his family build their own house with the assistance of local masons and carpenters. These houses encourage self-help construction and have scope for incremental growth and up-gradation unlike most houses built in the urban areas. The materials used are locally available materials like mud, thatch, stone, timber or indigenous building products like country tiles produced by the local masons. Use of local material like stone generates local economy by creating local production and consumption cycle. The use of local materials means lesser cost on transportation, is labour intensive and people already have the skills of construction. Another advantage of using local skills and materials is that it brings down the cost of construction and makes housing more affordable (Development Alternatives, 1986). "Thus it is of vital importance that government initiatives in housing begin to reach and strengthen the vast number of non-formal building material producers and masons in order to generate employment, which are also the only means available to the low-income groups for the improved shelter". The government can help to deal with these problems by directing its efforts and funding to not just house building but to technical, institutional and financial support for resource-based sustainable production systems within the housing programs and assist micro-industries invest in new more efficient producing units to improve productivity and shift from coal base energy to other form of renewable energy, with the aim to achieve long-term productive results (Aromar Revi, 1990).

Most local artisans have no access to modern tools of production or the technical know how that goes with it and depend on traditional materials produced by local production units. These producers have distinct advantages they work with products, technologies and design that involved local builders/masons and reflect local priorities. When developed into micro-enterprises they are perhaps the only good means to deliver building materials on a

widespread, decentralised scale. "...small and medium sized enterprises can satisfy the necessities of the world, it does not matter how it develops or what the state of growth is. These kind of enterprise provide people with the chance of relating to their familiar cultural and ethnic backgrounds, and they attract capital to the places where people live and not the other way around, taking people away from their homes in search of a source of capital." (Ramon Hortelano, at the Costa Rican AGSS seminar, November 1989, AIESEC, 1990). Despite these advantages the production unit owned by these producers are very outdated, mostly use coal for fuel and the enterprise owners wont invest in new units as funds are not easily available in order to invest in new technology packages and tools. "Limited resources in the industry make it difficult to prioritise protection of the environment over sales growth" and traditional businesses put more emphasis on short-term results instead of long-term opportunities of basing businesses on sound environmental principles. Environmental impacts assessment have been limited to short-term projects and not long term policy making process which does not allow the industry to look at the environmental impact and resource utilization from a life cycle analysis perspective (AIESEC, 1990).

"Given the futility of the state trying to build these houses and employing more people, latent demand in this sector can only be activated if building materials are made more cost-effective and easily available through an efficient delivery system" (Shrastant Patara, Towards Large Scale Dissemination of Sustainable Building Materials and Technologies, Development Alternative). With a view to propagate, disseminate and promote innovative and cost effective technologies and transfer them to the field situation the Government of India have launched major programme for establishment of a national network of building centres in 1986, so far 555 centres which serve the role of technology transfer on affordable and cost effective technologies from the lab to the field situation, train and upgrade skill of construction workers, produce and market building materials, construct cost effective houses, provide house guidance, counselling and information dissemination (HUDCO, 1998).

"Industry, instead of fighting an obviously losing battle against the environment and its defenders, should seek to constructively adjust and adapt itself, searching for the profits to be made in a world that is, perforce, more and more conscious of environmental degradation"(Michael Oppenheimer, a senior scientist at the Environmental Defence Fund

and head of their Global Atmosphere Program, at the New York, USA AGAA conference, April 1990, AIESEC)

The building material industry of India can be described as a diverse, traditional and very labour intensive industry but at the same time has been actively growing over centuries and adapted to new ways and technology. Each part of India has a unique form of architecture, which uses building materials that are locally available and produced (Development Alternatives, 1986). Although there are a large number of different native as well as popular building materials in India, mentioning all of them is outside the scope of this thesis. Thus for the purpose of discussion only the more popular and commonly used materials in rural and urban India along with and a few alternative technologies developed have been described in this section.

Commonly used rural building materials:

Soil and Soil Products: Earth had always been the most widely used building material in rural India and is also commonly used in urban areas among squatter dwellers, as it is easily available but the applicability of mud to urban areas is still limited. The common methods used for earth construction are cob, wattle and daub, rammed earth, abode, cut blocks and as plaster over woven bamboo walls. Although a large number of these houses have been lived in by three or more generations, mud is classified as a non-permanent building material. The reason that mud is classified as a non-permanent building material is probably because of the common perception of its limited life, strength and need for a high level of maintenance (Aromar Revi, 1990). One of the benefits of using earth for construction is its thermal insulation property. In recent past, research and development on mud as a building material and dissemination in the area of mud construction have made significant progress, however more emphasis need to be placed on this area, especially with the increase in large-scale rural housing programmes in the last few years (TERI vision, 2000).

Commonly used urban material:

Brick: Brick is the most common primary building material used not only in urban areas but also rural areas of India. Brick making is mostly a traditional, unorganised industry, generally confined to rural and periphery urban areas. These industries despoil agricultural topsoil and consume large quantities of firewood and coal in their inefficient (between 5-15% thermal efficiency) kilns. In most cases the quality of bricks produced is very low

(<30kg/sq.cm. crushing strength) due to the inferior quality of clay used and inadequate firing limiting the structural efficiency of the brickwork and the number of storeys. (Aromar Revi, 1990). The brick industry in India is the second largest producer in the world, next only to China, has more than 100,000 operating units, producing about 140 billion bricks annually with an annual turnover of more than Rupees 140 billion. However the supply of bricks is not keeping with the demands and the cost has gone up in the past two decades mainly due to the increased resource scarcity and difficulty in obtaining the fine clay needed and high cost for baking them and the high cost of transport to building sites. Coal has a high carbon emission and run inefficiently and the Indian brick industry is estimated to consume 24 million tons of coal annually (www.teriin.org). It is also one of the largest employment generating industries and employs millions of workers. Thus despite threats to flora, fauna and human health brick remains one of the most important building materials in India. And despite initiatives to introduce alternative-walling materials like compressed earth blocks, fly ash bricks, burnt clay bricks might still occupy the dominant position in the foreseeable decades (Energy saving in brick industry, www.teriin.org).

Brick-making industry is also an energy-intensive process (60,000 such kilns) the fuel costs alone accounting for almost 30-40% of the production cost and estimated consumption of more than 24 million tons of coal annually. Brick kilns (approximately 30,000 BTKs) that are generally of medium and large production capacities (2 million t0 10 million bricks per year) and coal are the main fuel for firing bricks. One of the reasons for high fuel consumption in terms of coal, firewood and other biomass fuels is the conventional inefficient practice of firing clay bricks in the bull trench clamps a popular method of brick production in the northern part of India responsible for 65% of brick production. The peninsular and coastal India accounts for the rest of the 35% (production capacity generally ranging from 0.1 to 3 million bricks per year). Clamps and moving chimney bull trench kilns are used for firing bricks in this region.

Brick kilns are classified into three categories: small kilns called the clamp kilns and are located mainly in rural areas (<1 million bricks/year), medium (1-2.5 million bricks/year) and large (>2.5 million bricks/year) kilns called bull trench kilns and are generally located near urban areas. Brick making is a highly energy intensive process, with a specific energy consumption of 1.2 to 1.75 MJ/kg of fired bricks for bull trench kilns and 1.5-3.0 MJ/kg of

fired bricks for clamp kilns. Low efficiency in the firing of bricks leads to high levels of PIC (product of incomplete combustion) emissions. The production capacity of bull trench kilns are generally large from 15,000 to 50,000 bricks per day, but due to the high emission levels from the moving chimneys used on BTKs, the standards set up by the Ministry of Environment and Forest, Government of India from 30 June 2001 has banned the moving chimney bull trench kiln and specifies replacement with fixed chimneys and other efficient brick kilns. Figure 3.14 given below shows that the moving chimney crosses the national emission standard, which is 750mg/Nm cube. It also shows the comparison maximum and minimum emission of SPM (suspended particle matter) in stack gases in the chimneys of three kinds of kilns which are; the vertical shaft brick kiln, fixed chimney bull's trench kiln with gravity settling chamber and moving chimney bull's trench kiln. In the year 1996, the Government of India set emissions standards for brick kilns and these regulations have brought about some technological improvement in a section of the brick industry in the areas of emissions and fuel savings (www.teriin.org).

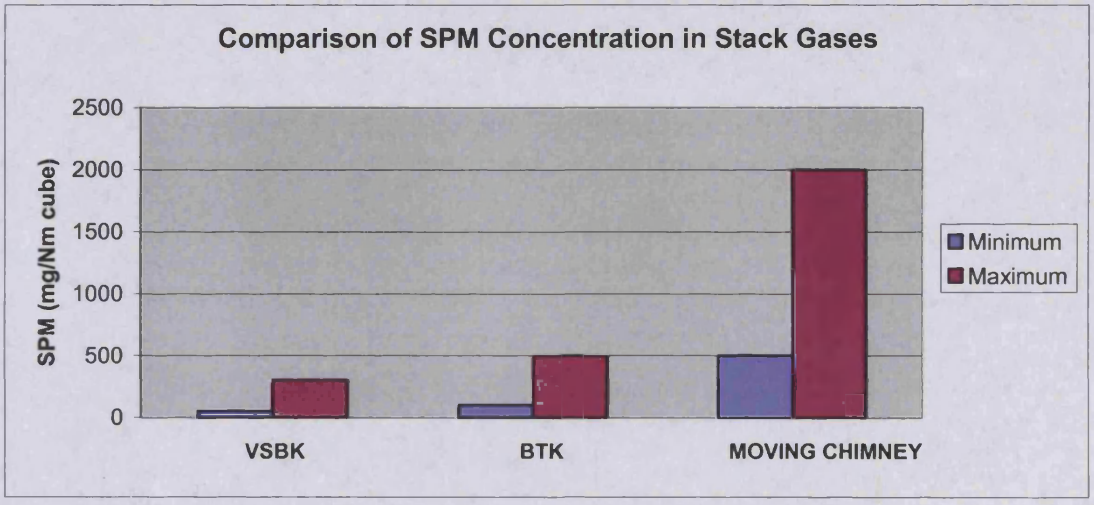


Figure 3.14

An energy efficient method of firing bricks resulting in an energy saving of 30% compared to bulls trench kiln and more than 50% compared to clamps called vertical shaft brick kilns taken from China have been recently implemented in India. They are also compact and require a small area of land, about $1/4^{th}$ compared to bull's trench kilns, easy to operate and do not require electricity to function. VSBK has a roof and so can be operated during monsoons unlike other traditional kilns without roofs and can operate only for 5-6 months

in a year. They have shown substantial energy savings by curtailing the inefficient use of fuel wastage of production and high emissions of greenhouse gases like carbon dioxide. Because of its fast firing property vertical shaft kiln is particularly suited for firing of bricks containing internal fuel like agricultural residue like rice husk or fuels like coal dust can be used reducing production cost. The construction cost of vertical shaft is slightly higher compared to bull trench kiln it is still reasonably low, rupees 3.5 lakh (£4500) for a production capacity of 5000 bricks per day. The quality of the bricks produced are better in terms of colour, ring and compressive strength and additional shafts of production capacity of 2000-5000 bricks per day can be easily added/operated. The specific energy consumption of clamps is 1.5-2.5 MJ/kg of fired bricks, fixed chimney BTK is 1.1-1.5 MJ/kg of fired bricks and VSKB is 0.75-1.0 MJ/kg of fired brick and these results are taken of the emissions as well as the energy use on BTKs from a study conducted by TERI (Tata Energy Research Institute, New Delhi) by monitoring 21 Indian brick kilns and shown in figure 3.15 below. (Resource utilization in improvements in brick industry, TERI, New Delhi, www.teriin.org).

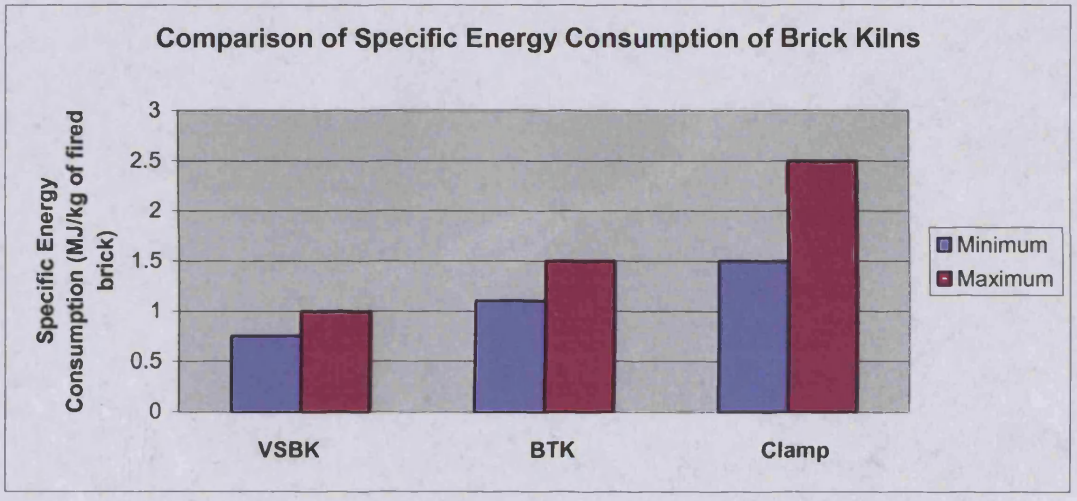


Figure 3.15

Cement: Another popular building material is cement. It is one of the largest formal well-established building material industry in India with a massive capital investment and an annual production of over 30.1 million tonnes per year (1987) and employs over 1,00,000 workers in more than 110 large and small plants "Cement is produced in India in centralized plants and transported over great distances at substantial cost, but given the future resource constraints of finance, electricity, coal and limestone in the country,

extensive use of cement will have limited economic viability and sustainability" (Aromar Revi, 1990). The use of cement in housing had been limited until the late sixties when high-rise construction brought it into extensive and wastefully used as mortar and as plaster. Although widely used in urban construction, cement is still not very affordable to the poor section of India and hence need to be produces more efficiently or alternative materials that substitute cement need to be developed. Concrete block is an extensively used cement-based product used like any other masonry unit to build foundations, walls etc. A typical block is equivalent to 4.5 bricks, which makes it faster to build with compared to other masonry units The size of a typical block is 300x200x150mm. They can be used in combination with most roofing materials like RCC, RBC, ACC sheets etc. Plus they are popular in institutional and industrial buildings especially in urban buildings due to its long lasting and low maintenance properties. Cement based products are also preferred among rural households as they see it as more durable product (Concrete Block Technology, Development Alternatives).

Alternative Technology:

Most of the technology developed originates from developed countries and transferred to developing countries with concern for applicability, technological know-how and ways to integrate new technologies with traditional methods. Very little innovative work has been done to improve tools for buildings and the improvement of hand tools and equipments would do a great deal to increase production and promote more employment opportunities for unskilled labour, particularly women (Aromar Revi, 1990).

"To achieve sustainable development, we need to develop and provide technology that is essential to our future development" and " All countries need access to basic technologies, which will provide them with a better way to use their resources and allow them to survive in a sustainable manner" (AIESEC, 1990). Along with conventional building materials options, there are options of alternative technology materials available in the market today adoption of which would make the development process more economically efficient, self reliant, socially equitable and environmentally sound (India: Environment Priorities, 1991). Although alterative technology materials have been developed by R&D institutes like CBRI (central building research institute), HUDCO (human settlements management institutes), Development Alternative etc all over India, but they have not yet managed to reach the masses on larger scale and faster rate.

Some of the alternative technology materials developed are described below:

Micro-Concrete Roofing (MCR) technology: is a product of R&D for the poor and it offers the lowest cost for permanent roof in India which is quarter the cost of reinforced cement concrete and half the cost of asbestos cement concrete sheets when laid over local wood under-structure, steel under-structure and they provide great flexibility with uneven under-structure in comparison with A.C.C. sheets and can be used as a cladding material. And appropriate for all areas where pitch roofs are common, the tiles are water- proof, fireproof, insect-proof and hence they are more durable than thatch roofs.

MCR is a roofing tile made of cement mortar vibrated on a table at a controlled frequency and set on a mould to take its form using a mix of; cement, fine sand, coarse sand and fine aggregate. These tiles are lighter and longer than traditional tiles and therefore use less under-structure, less permeable than traditional tiles and thus a single layer is adequate for moderate rainfall areas. The grooves ensure better interlocking of the tiles and thus prevent leakage of water, thermally more satisfactory than A.C.C. sheets and can be manufactured locally with low capital investment using local raw materials, is environmentally sound and the technology package creates building material and local jobs. A micro-enterprise can install a unit for only rupees 90,000 (£1= rupees 80 approx) to produce roofing material for 300 dwellings every year, provide seven jobs and get full return on investment in just 18 months.

There are more than 120 units already operational, 85 of which are private businesses, with the rest being operated or supported by local voluntary agencies. To date, over five million tiles have been installed on roofs in two years. This represents roughly 400,000 square metres of improved roofing and approximately rupees 90 million worth of goods and services bought by people without any subsidies (Appropriate Building Systems Instruction Manual, 1993). Table 3.3 in the flowing page shows the comparison of its characteristic with other roofing materials the county tile and ACC.

Comparison with other Materials:			
Characteristics	**M.C.R.**	**Country Tile**	**A.C.C**
Cost Range (Rs./Sqm.)	105-170	290-370	220-280
Unskilled Labour (%)	18	12	7
V.E.C (%)	32	51	15
Level of Skill Required	Medium	Medium	Low
Resistance to Water	High	Medium	High
Resistance to Wind	Medium	Medium	Medium
Thermal Capacity	Medium	Medium	Low
Stage of Acceptance	Initial	Widely Used	Widely Used

Table3.3 (Appropriate Building Systems Instruction Manual, 1993)

Compressed earth blocks: are appropriate for all areas. Compressed Soil Block are made by compressing loose soil with optimum water content in a manual machine and then dried in the sun and stabilizers like cement or lime are added to increase the resistance of the blocks to erosion by water. Compression improves the strength of the block and hence it capacity to carry load. They have a low resistance to abrasion or impact, unless adequately stabilised and they have to be treated against termites and rodents. Soil should be tested for suitability before use, since stabilizers react with clay in the soil to form a binder. The degree of stabilization depends on the amount of clay. Cement (3-6%) is used with low clay soils while lime (4-8%) is used with clayey soils. Soil should consist of clay (8-25%), sand (40-75%), silt (15-25%) and fine gravel (0-10%)

The quality of the soil block depends upon the soil mix used, moisture content of the mix, compaction effort exerted and the production rate. The production of these blocks also supports the village economy, as it is skilled as well as unskilled labour intensive (Appropriate Building Systems Instruction Manual, 1993). Table 3.4 below shows the compressed soil block characteristics in comparison to other walling materials, which are burnt brick and random stone.

Comparison with other Materials:			
Characteristics	**Soil Blocks**	**Burnt Brick**	**Random Stone**
Compressive Strength (Kg/Sq.cm)	25-45	50-70	80-110
Slenderness Ratio	16	18	15
No. of Stories (Load Bearing)	2	3	3
Cost Range (Rs/Cum)	400-875	700-900	650-750
Unskilled Labour (%)	44	11	16
V.E.C (%)	56	22	33
Climatic Suitability	All Except	All	All

	Wet Climates		
Resistance to Water			
With Plaster	Low	Medium	High
Without Plaster	Medium	High	
Resistance to Termites	Medium	High	High
Level of Skill Required	Medium	Medium	High
Transportability	Low	High	Medium
Stage of Acceptance	Initial	Widely Used	Widely Used

Table3.4 (Appropriate Building Systems Instruction Manual, 1993)

3.5 Discussion:

Social Aspects of Sustainable Shelter Development:

Social Hypothesis *Urban housing conditions do not satisfy the general housing needs of the dweller.*

In this section a review of social and cultural influences in the past on shelter and their present influences on shelter requirements were carried out in order draws links to the users socio-economic practices and processes, needs, preferences and satisfaction levels from present urban dwelling conditions. According to this review certain socio-cultural needs and practices of the past, such as privacy and social and private spaces, spaces for socialising and spaces for carrying out day-to-day activities are still considered important today. Other examples are comfort, climatic design and passive processes, recycling, re-use and user participation. According to the data reviewed, traditional houses in the past were built with inputs from the user giving consideration to their needs, which in turn evolved, from social and cultural needs, habits and practices. However most of these very diverse and unique elements of social and cultural needs are no longer integrated into urban shelter forms and in most cases user inputs and participation absent. And most urban shelter forms are rigid, mass units built to cater to a single community, which is the urban community. For instance, in some regions traditional planning also had provision for spaces for social interaction and carry out celebrations etc, (an integral part of Indian Culture) such as communal courtyards, which also keep the indoor temperatures cool during summer, which are gradually disappearing. Apart from socio- cultural needs, shelter also affects people's private needs; it provides comfort, protection and security from external elements, for some it's a workplace and for some the construction industry is an employer. The percentage of

urban households having no access to basic shelter and other services are indicators of social inequality and poor quality of life of the masses.

This review indicates that in order to deal with shelter problems and address user needs, qualitative as well as quantitative shelter needs have to be addressed simultaneously with the support of appropriate policy changes, and implementation of cost effective, energy efficient and employment generating participatory shelter planning systems. Promoting user participation would also help promote sustainable lifestyles and generate awareness through formal and informal education.

Therefore in general this review supports the hypothesis developed that people's social, cultural and individual needs are not being satisfied and informs the issues which need to be addressed in the following case studies conducted. This study identified the need to inform people about issues concerning shelter. Which could be addressed by adopting measures such as developing informal education programs that target all section of the community (literate and illiterate), link in with formal and adult education programs etc. More awareness could also be generated through participation, which also inform the public and private sectors about people's social, cultural and individual needs.

Economic Aspects of Sustainable Shelter Development:

Economic Hypotheses *Basic housing in urban areas remains inaccessible to the masses due to high shelter costs and budget constraints of the households and public sector shelter providers.*

In this section review of factors such as urbanisation, development, employment, population growth and poverty helps to identify constraints in provision of adequate housing. This study suggests low budget availability and high cost of shelter are also likely to influence affordability and access to basic shelter. Rural poverty gets transferred to urban areas in the form of rural/urban migrations. The rural poor migrate to urban areas looking for better opportunities, which add to the existing booming urban population - a consequence of urbanisation. This review suggests that the urban population has grown rapidly while shelter; infrastructure and the paying capacity of the masses have not grown accordingly. Poverty as problem concerns urban as well rural areas a consequence of unemployment and an ongoing problem especially among the developing and underdeveloped worlds. In India, present pressing needs of the country are food, shelter

inadequacies and poverty. As a result, Government policies and schemes tend to focus on economic growth and development of the country, while environmental concerns often come secondary. However this review also suggests that development and progress does not necessarily reduce poverty especially when the wealth generated is not equally distributed and goes to a handful section of the community only. Leaving a larger percentage of the community poor and unable to afford basic shelter and services, which are the bases of a good quality of life. Official reports suggest that the reasons for shelter crises among other things are also low budget allocation. However, although budget is an important factor, which determines how much and what is affordable, careful use of funds and resources available can make considerable impacts. Suggesting that shelter can become more affordable to the masses by incorporating cost and energy efficient technologies and materials.

This review suggests that in order to make shelter more affordable, two main areas need to be addressed simultaneously, one- more employment generation and two- reducing basic shelter costs by adopting more cost-effective technology and materials. Low-income group and economically weaker section also need to be given more opportunities to access shelter though options such as giving the squatter dwellers land ownership. In addition rapid and unchecked development is not without consequences on the environment the most obvious ones are resource depletion and pollution, which are also indicators of unsustainable development.

This review supports the hypothesis developed and suggests that one of the main barriers to access to basic shelter is poverty. Hence actions needs to be adopted to make shelter more accessible to the masses by adopting cost-effective measures, more employment generation through the construction sector, re-use, re-cycling, use and promotion of local products (which reduce transportation costs).

Environmental Aspects of Sustainable Shelter Development:

Environmental Hypotheses *General comfort conditions are unsatisfactory in urban housing.*

According to the review various aspects likely to affect user comfort with respect to shelter are adequate lighting, shade, space, infrastructure service provision, the thermal properties of shelter, passive and mechanical heating and cooling systems. The review also provides information on energy use and its impacts, such as embodied energy and global warming.

According the information gathered in the social aspects of the review cultural traditional practices such as passive forms of design like use internal courtyards and thermal mass were used to tackle comfort issues in an efficient and responsible manner and catered for all sections of the community. Unlike mechanical systems adopted in present times most of which are accessible only to the richer sections. The human body can respond and adapt to minor changes in temperatures, however the adaptive capacity is limited to minor variations and cannot adapt to rapid and extremes changes. In the case of extreme thermal discomfort most individuals with turn to mechanical systems, however the poorer sections with financial limitations will have lesser capacities to adapt. Hence passive planning plays a very significant role in thermal comfort provision among the poorer sections. Also consequences of energy and resource intensive consumption patterns of the more affluent and developed countries are likely to be borne by the poorer section of the population.

This review suggests that most shelter units are not adequate in terms of comfort and service provision. Most units require additional mechanical support in order to provide comfort. Hence energy use and dependence among the more affluent groups are rising with respect to domestic operational energy use. In addition the embodied energy of must urban units are also high due to the use of energy intensive materials like brick (mostly produced in inefficient kilns run by fossil fuels). At present the embodied energy most urban shelter units are likely to be higher than years of domestic operational energy use.

This review suggests that although globally the energy and resource consumption in developed countries is much higher than developing countries. As mentioned in the review, every country must take their share of responsibility for the environment as the impact of forest depletion in developing countries and carbon dioxide emissions by developed countries will affect global climate and their mutual futures.

In the context of long-term planning, integration of passive planning systems in buildings among all shelter types and use of climatically suitable materials should be made compulsory for planners and architects in order to reduce the use of and dependence on mechanical cooling/heating and other electrically operated systems. In order address the issues of quality and comfort within sustainable limits, embodied energy and running energy in shelter needs to be addressed simultaneously. Efforts should also be directed towards measuring and reducing the amount of embodied energy in buildings, which would also contribute towards long-terms energy and cost savings. This could be easily achieved

by adopting local materials, which would also promote local economy. Since transportation is a major contributor to the energy content of a product.

This review supports the hypothesis developed and directs the study towards shelter issues, which need to be addressed in the following case studies. This review suggests that shelter conditions with respect to comfort are not satisfactory and need to be addressed. However comfort and health issues need to be addressed using measures which are appropriate in terms of environmental protection and efficiency but also in terms of individual/household capacities specifically with respect to spending capacities (long-term and short-terms) and the adaptive capacities of the masses.

Political Aspects of Sustainable Shelter Development:

Political Hypotheses *Housing policies and programs are based on based on public body understanding of user needs and not on real user inputs.*

According to the data collected in this review, at present, Government policies and reforms are more focused on development issues such of employment generation, population control and economic development. In the area of shelter, however according to some reports not adequate attention is given as compared to the magnitude and nature of the problem. Also review of past and present programs are indicative of the targets set for housing developments in order to provide basic housing for all, however there are no set targets for the quality control and monitoring of these units. Government actions over the years have neither been able to close the housing gap nor have the shelter conditions improved. One of the reasons for shelter targets failing to be achieved could be the lack of accountability, transparency of administrators and non-implementation of the programs and policies drawn. For instance in order to improve the quality of squatter settlements, policy shifts were made from slum relocation to in-site up-gradation during the late seventies, but the policy has not been properly implemented. Also in order to address the qualitative aspects of shelter, user participation has been recognised as essential, by shelter policies. However despite this recognition, policymaking lacks any form of public participation and inputs, and polices and programs are still being developed on the basis of perceptions and presumptions of bureaucrats and not user inputs.

Government bodies need to have a clear understanding and implications of programs and policies not only at the macro level but also at the micro level, urban and rural level. For instance in order to deal with the problem of urban housing, rural economy will need to be

revived which in turn would reduce rural to urban migrations. Existing rural industries and traditions such as locally available traditional materials and local crafts should be revived by creating markets for local products and used in present mass developments in order to create local employment as well as conserve age old traditions.

Since the urban population is likely to continue rising and so will the demand for food and shelter. Therefore in order to support the existing urban population along with the migrant sector, industries including the shelter industry should become more labour intensive therefore creating more employment. Since the construction industry has tremendous employment opportunities, policies should promote and support systems that more labour intensive in operation. Government bodies should also provide financial and advisory support for upgrading local productions units for more efficiency resulting in more cost and energy efficient materials and encourage local businesses to adopt more efficient systems. Government bodies should also provide financial and advisory support to informal building material producer's, masons, small contractors and second hand material dealers who are more accessible and affordable to the poor and low-income groups. This study suggests that solutions to the problems of social housing and infrastructure services can only be achieved though the formulation of sound national housing policies and programmes, which involves user participation and based on user needs and their efficient and effective implementation. No amount of policy changes will work unless people understand the political decisions made and are able to make the correct choices not only in the area of their shelter needs but in policy making by voting for the right political candidates representing their needs.

This review supports the hypothesis stated above and suggests that public bodies are not informed on user needs and requirements and vice versa users are not informed about public polices and programs concerning them such as shelter and services. Therefore polices and long-term strategies need to be placed in proper perspective which includes community inputs and requirements as well. Which can be addressed through communications and participations programs created for communities and individuals.

Technological Aspects of Sustainable Shelter Development:

Technological Hypotheses *Despite efficient alternative building material options present choices adopted are not cost, resource and energy efficient.*

Conventional materials comparatively are more energy intensive and fuel dependent in production and therefore are likely to have high-embodied energy content as well. Whereas information gathered on some alterative materials suggest options, which are not fuel dependent in production, sun dried bricks likely to have a lesser-embodied energy content. In order to make alternative, appropriate materials and technology more accessible a number of research institutions and building material centres have been set up all over the country. These institutes aim to introduce, promote and provide training on skills to develop and use existing alternative building materials like compressed earth blocks, fly-ash bricks. However materials like burnt clay bricks and cement are still more popular and still widely used between builder and client. This indicates that public acceptance to new technology and materials are slow. Therefore more effective and alternative ways of marketing of new products by educating and informing users of product advantages and disadvantages need to be adopted. Informing the users on the effects of their choices on costs and impacts on the environment may encourage them to make more efficient choices. This in turn would increase production by creating demand for more alternative technologies and materials and in turn become more income and employment generating then present inefficient manufacturers.

One major drawback some of the alternative materials are likely to face is the need for evaluation of performance. For instance fly-ash brick, which is a low cost low energy product, manufactured from chimney waste collected from thermal power plants and is already being used for construction in a few sites, however the toxic effect of the product is not known yet.

Also since popular materials like brick, is one of the largest employment generating industries and employs millions of workers. Completely substituting this industry with other materials would lead to large-scale unemployment for the millions of workers. Hence research and funds also need to be directed into developing more energy efficient and better quality bricks with improved thermal properties. This review suggests that the only way to deal with growing shelter disparities is to either increase the shelter budget allowance or find other effective solutions to deal with the problems, such as a more wide scale adoption and promotion of cost-effective technology and effective utilization of existing informal recycling networks and re-use of building materials in construction. This review suggest that while the adoption of alternative technologies by the masses is likely to be a gradual

middle and long-term process, improving the efficiency of existing production units can be adopted as a short–term solution.

This review supports the hypothesis developed. Data reviewed in this section suggests that despite a variety of alternative options available in the market urban housing are not adopting more energy intensive technologies and building materials. Hence more efficient options need to be adopted by encouraging more users and builders to adopt more efficient options (provide subsidies etc). Also efficient options need to be better marketed and made more accessible to the common man.

3.6 Conclusion:

From this review it can be concluded that basic shelter is not accessible to the masses, hence a larger percentage of the urban population live in informal settlements where due to lack of space and poor access to basic services shelter conditions are unsatisfactory. According to this review basic housing in urban areas remain inaccessible to the masses due to high shelter costs and budget constraints of the households and public sector shelter providers. Review suggests that shelter inadequacies in urban area are mainly due to factors such as population growth, poverty, wealth distribution inequalities, unemployment and funds and resource limitations and inefficient and improper use of resources. The data collected on the growing number of urban slum populations living in poor conditions is an indication of the scale of inequality and the quantity and quality of shelter problems. Most forms of urban shelter catered for the masses are mass-produced in order reach targets and often are not based on informed user needs, nor are they built with consideration towards socio-cultural, climatic needs and basic needs such as adequate space, lighting, ventilation and access to water electricity etc in informal settlements. Hence the review suggests that present urban shelter conditions formal and informal with respect to general comfort are unsatisfactory and most used are not based in user inputs. Micro aspects of shelter such as design and macro aspects such as shelter policies lack any form of public participation and inputs, and developed on the basis of perceptions and presumptions of builder, designers and policy makers. Also suggests that present urban shelter forms are not resource and energy efficient.

Chapter IV

Stage A Case Studies

4.1 Introduction: This chapter discusses the investigations carried out in the three stage A case studies conducted of housing developments in three urban areas of India. The aim and objectives of the stage A case studies are introduced followed by a brief description of the methodology adopted for data collection. Each case study is then analysed, results drawn and summarised separately. Finally based on the findings of the case studies hypotheses set B is developed which will be used as a base for investigation in the stage B case studies.

4.2 Aim- The aim of the stage A case studies is to study the micro day-to-day shelter needs and concerns likely to affect the respondents quality of life and the implications of the lifestyles and shelter processes adopted to satisfy their needs. This is turn is aimed in directing the study towards priorities within user needs and environmental concerns of sustainable shelter development. As mentioned earlier these studies will also be used to pilot the investigations.

4.3 Objective of this study: To carry out three case studies of urban housing where the sustainable aspects of shelter will be investigated by testing the set A hypotheses developed. In order to test the hypotheses, set A questionnaires and set A interview questions developed will be used among the respondents.

The case studies are as follows:

1. **Stage A Case Study 1** A middle income group (MIG) housing development in New Delhi and implemented by Delhi Development Authority (DDA)
2. **Stage A Case Study 2** A low income group (LIG) housing development in Kerela implemented by Costford
3. **Stage A Case Study 3** A low income group (LIG) and lower middle income group (MIG) housing development in New Mumbai implemented by City and Industrial Development Corporation Limited (CIDCO)

Figure 4.1 given in the following page shows the location of the three urban areas:

Figure 4.1

Given below in figure 4.2 is the structure adopted for this study:

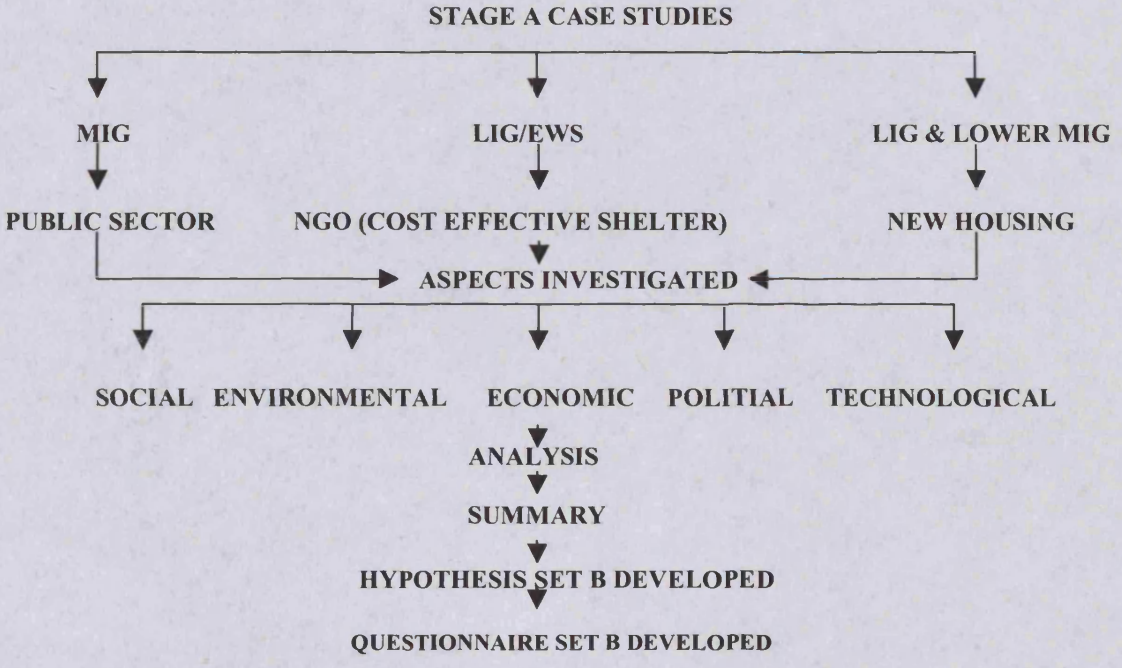


Figure 4.2

4.4 Methodology Adopted: The methods adopted for data collection is as follows:

Methods of data collection- Questionnaire Set A Survey (Appendix 1)

Structured Interviews Set A for households (Appendix 2)

Structured Interviews Set C for planners (Appendix 5)

Site Surveys

Secondary data collected

4.4.1 Set A questionnaire: The main survey tool adopted in this study is a questionnaire developed in order to aid in the investigations of set A hypotheses. The questionnaire developed aims to find out areas of user concern, dissatisfaction, needs and awareness levels plus their recommendations. The questionnaire has been categorised into four sections and consists of 23 questions. Although individual needs may vary, effort has been made to include variables, which represent basic user requirements and in some cases option have been left open for user to fill in. Most of the questions have an option of yes or no which have been number coded and converted into percentages. The open-ended qualitative questions have been used in order gauge the respondent's attitude and awareness levels have been post coded. The results have been presented in the form of tables and additional information acquired has also been discussed at the end of each section.

Section one begins with general questions on social aspects. The social context questions have been developed in order to find out satisfaction levels concerning shelter and find out the indicators, which are more likely to affect user comfort, satisfaction levels and preferences. The question on awareness level has been developed as an indicator on preferences, whether awareness levels and product familiarity/exposure has any bearing on user preferences and lifestyles choices. The questions have been developed with the aim to enhance an understanding of other areas such as cultural and social influences, which affect user choices and lifestyles. The next sets of questions are based on the economic aspects and have been developed in order to find out factors, which have impact on shelter costs such as budget and variables such as materials and technologies adopted, and location as indicators of shelter affordability. The environmental questions were developed to see whether the absence or presence of climatically suitable design determined energy use, whether urban households are dependent on mechanical systems for indoor comfort, their views on energy use and what according to them are the factors that affect comfort. The

question on awareness to shelter policies and schemes was developed as a predictor of product advertising, product accessibility, product exposure and the respondent's level of involvement concerning macro level shelter aspects (where schemes, policies innovations have been referred to as product). The last set of question are concerning the technological aspects of shelter and the questions concerning preferences and inputs on alternative technologies have been used as indicators of more popular and widely accepted materials, the reasons as to why and what are the widely accepted properties of these popular materials.

This questionnaire has been developed to help access what the present situation of most urban housing developments are, whether based on user needs, their expectations, attitudes and awareness levels on current issues affecting them and their quality of life. Based on the results of this study, set B hypotheses will be developed and set B questionnaire will be developed which will be investigated in stage B case studies.

Barriers Encountered: The drawbacks in the questionnaire tool used during the case studies surface only came out during the analysis stage of the study. The main drawback was in the structural format mainly the absence of multiple tick box options. In this questionnaire only yes or no option was provided, which although gained straightforward answers from the respondent, did not give the respondent the choice for a neutral opinion. Another problem was the lack of response for certain questions where certain scientific terms were used. This problem also become evident during case study II where the questionnaire surveys were conducted through interviews, where the scientific terms had to be simplified and translated. Thus in set B questionnaire the terms have been kept simple and simple day-to-day questions have been used to determine relating factors.

4.4.2 Set A interview questions: The additional method of data collection used in this study is a set of structured interview questions developed for the purpose of interviewing the residents. The interviews were mainly conducted in order to gain more insight and also back the questionnaire study. The interviews have helped provide additional information on household's quality of life, family size and general lifestyle choices. The interview data have been recorded mostly as notes and tapes (where agreed upon) and the data post-coded and transcribed during the analysis stage.

Barriers Encountered: the problem faced was mainly language barrier, as most of the interviewees among the EWS/LIG groups only spoke either local dialects or basic Hindi. Thus most o the interviews were conducted in Hindi and where local dialect was required the help of a translator was taken. Most of the interview data was written down in the form of shorthand notes during the interviews and later developed into full sentences in English. Another problem encountered was the difficulty of finding residents during weekday site visits as most household members worked during the day. Therefore later site visits were either carried out during evenings or during weekends. Since Case study I proved to be easier being the city of domicile compared to problems encountered in terms of time, money and accessibility in New Mumbai and Kerala, hence all stage B case studies are chosen in New Delhi locations.

4.4.3 Set C interview question (refer to appendix 5): developed for the purpose of interviewing the planners and developers of this case study housing or members part of the executing bodies. These interviews were conducted in order to find out more about the shelter structure, technologies adopted, present issues affecting shelter and how they are being dealt with. The interview data was recorded in the form of written notes.

4.5 Stage A Case study I – Housing development in Vasant Vihar, New Delhi

4.5.1 Introduction: Stage A case study 1 is a middle-income group (MIG) housing in New Delhi, implemented by Delhi Development Authority (DDA). The site visits were carried out during the month of July 2000. A questionnaire survey and structured interviews were conducted of the residents. 100 copies of set A questionnaire (refer to appendix 1) was distributed among the residents during the site visits and collected back in end of the month and a response of 15 numbers were received. Interviews were also conducted of residents (10 in number) using structured set A interview questions (refer to appendix 3). An interview of one government DDA official using set C interview question (refer to appendix 5) was also carried out. Secondary data used is from official reports and some survey reports conducted by the DDA acquired during three site visits to DDA official building.

Design and Execution: DDA (Delhi Development Authority) Public Sector, Government of India

Background on DDA (Delhi Development Authority)- DDA was constituted by the Government of India to plan and execute the development of Delhi in order to provide shelter, amenities and facilities to its existing population. It was also meant to make provisions for future growth. According to official reports, DDA was India's first development authority and thus faced challenging tasks of planning and implementing an integrated development strategy. Which was to be cost effective and at the same time functionally utilitarian, environmentally sound and aesthetically appealing and preserve the rich heritage of the city while catering to scenario of the future. DDA formulated a Master Plan in 1962, which was modified in 1990 with perspective up-to 2001 but due to the massive growth of Delhi in the nineties both demographically and spatially a further revision of Master Plan up-to 2021 is under preparation. Till date DDA has acquired 63410 acres of land out of which 59319 acres have already been developed for residential, commercial, industrial, horticultural, institutional and recreational uses. DDA started constructing residential flats in 1968. It floated 23 housing schemes from time to time for various income groups. Till March 1998, it has constructed as well as facilitated construction by providing land to individuals, Co-operative Societies, resettlement colonies and 1.44 million dwelling units, 60% of these dwelling units are for the weaker section and low-income groups. The DDA constructs houses of various categories viz. EWS/LIG/MIG/HIG etc. for a large number of registrants (www.DDA.com).

4.5.2 Location: Vasant Vihar housing sector is situated in Vasant Marg road in the South-west part of New Delhi.

4.5.3 Procedure: Regular site surveys were carried out during the month of July 2000, visits to the DDA office building was also carried out in order to interview DDA officials and collect official data relevant to the study.

Initial site surveys were conducted during the day but due to the absence of households during daytime later surveys were conducted during evenings and questionnaire survey and interviews were also conducted during that time. (During the day due to high temperatures most people stay indoors, also among most MIG households the family members work full-time and the children are in school till 2pm).

The questionnaires were randomly distributed among the residents of the locality building blocks of sectors C and D during the site visits, and collected after a month from which a response of 15 numbers was received. Where agreed upon structured interviews were conducted and a number of 10 resident interviews were acquired. Interview data was written down in the form of notes and key words. Additional data gathered of 3 interviews people living in public houses has been used for the purpose of this study. Site visits were also made to the DDA office department, and an interview of a DDA engineer official was also conducted during one visit. Also these visits provided access to a number of official publications, which have been used to support this study. The questionnaire data collected were numerically coded and converted into percentages. Data from open-ended questions and interviews were numerically post-coded and all results presented in the form of tables. Qualitative question responses have been categorised and fit into pre determined aspects and has also been discussed in the analysis section. Photographs taken during the site visits have also been used to support the study.

4.5.4 Analysis: In this section of the study the social, economic, environmental, political and technological aspects of this shelter development will be investigated in order find what are the their needs, expectations and areas of dissatisfaction in addition to what they think of sustainability, energy use, energy conservation and shelter policies.

Details of the apartment (one sample): The detail of an apartment based on the data collected during site observations and area details from the official data are as follows:
The covered area of each flat is 88.68sqmetres, area of the staircase block is 5.41sqmetres and the area provided for scooter parking is 3.11 sq metres (official plans). The number of floors in each building block is ground+3 and two flats on each floor; each flat has bedrooms (2 in number), living room, kitchen, 2 toilets (2 in number) and balcony (2 in number) along with the area for the scooter parking and a common staircase. The main building material used is pre-fabricated concrete blocks of a dark grey colour shown in figure 4.3 given below.
A standard design has been used for all the flats and the interiors are left undone for later incorporations and personal additions to be made by the residents. Although changes can be made only to the interiors and building regulations prohibit any external or structural

changes. However residents have made structural changes, which can be seen in the figures 4.3 below and 4.4 given below.

Figure 4.3

Figure 4.4

General opinion of respondents: The question on what major issues they thought affected present shelter most respondents felt that the major issue affecting shelter today was technological. The responses are shown in the table 4.1 given below.

What do you think are the major issues affecting shelter today?

Social	Economical	Environmental	Technological
0	1	2	13

Table 4.1

Social Aspects of Shelter: According literature review, the social needs of an individual covers a wide range of issues such as need for privacy, a say in decision making process,

need for social interaction and a good quality of life etc and may vary from individual to individual. However in this section will focus not on these needs but whether these needs of the user are being satisfied. This in turn will help gauge the general user/shelter compatibility and determine if user needs in general have been considered in the planning of their house. In addition their inputs on location preferences, demand for a particular house type, awareness levels will contribute towards a better understanding of user preferences of this group.

Social Hypotheses *Urban housing conditions do not satisfy the general housing needs of the dweller.*

Questionnaire survey data:

Satisfaction levels of the 15 questionnaire respondents

General conditions: In response to the question of general satisfaction from their shelter units, most respondents responses suggested they were not entirely satisfied with their units most responses being not so straightforward as yes and no but responses like 'to some extent', 'to an extent', and 'pretty much' were common and have been put under moderately satisfied response. All the responses have been number coded and similar responses assigned same numbers and designated into pre-determined categories. These responses suggest that user level of satisfaction is moderate this housing development. The responses are shown in the table 4.2 given below.

Are you satisfied with your home?

Yes	Moderately Satisfied Responses	No
0	13	2

Table 4.2

Service provision: In response to the question on satisfaction on the provision of services, the responses were more straightforward with a higher number of the respondents expressing dissatisfaction with the services provided. The results are shown in the table 4.3 given in the following page.

Are you satisfied with the services networks provided?

Yes	Moderately Satisfied Responses	No
0	1	14

Table 4.3

Incorporation of their needs and preferences in design and planning of their home

In response to the question of whether their needs and preferences were taken into consideration in design and planning of their home a higher number of the respondents responses were 'no' and 'not really' and have been slotted together under no. Only three respondents from the 15 respondents felt that their needs and preferences have been considered. The results are shown in the table 4.4 given below.

Do you think people's needs are taken into consideration in planning and design of their home?

Yes	To an extent	No
2	1	12

Table 4.4

Preference to house type: In response to the question on demand for a particular type of housing from the option of low and high rise most respondents opted for low rise and few opted for high rise, while one two respondents ticked both. The results are given in the table 4.5 given below.

Do you think there is a demand for a particular type of housing these days?

High Rise	Low Rise	Both
3	10	2

Table 4.5

Preference in location: In response to the question on choice of location, most of the respondents said they preferred suburbs due more greenery and fresh air and since the telecom service had improved, so some respondents said they would prefer suburbs only if transport services were good and well connected to the city. All these responses have been

slotted together under suburb, while 4 respondents who gave preference to the city have been slotted together. The results are given in the table 4.6 given below.

Would you prefer to live in the city or the suburb?

City	Suburb
4	11

Table 4.6

User Level of Awareness

General awareness: The following question was developed in order to gauge the respondent's awareness levels concerning passive systems in design. Responses received indicate that a higher number of the respondents were aware of the use of windows and ventilators for ventilation and shading devices for protection from the sun. Site visits also indicate the use of additional shading by households. One respondent was aware of the use of climatic factors and sunpath analysis. The results are shown in the table 4.7 given below.

Do you have any idea on what is done to improve solar gains, shading, cooling, ventilation and lighting?

Space Design	Windows for ventilation	Shading devices	Climatological factors
2	12	9	1

Nothing much is done on this side of stream: 1 respondent

Table 4.7

Sustainability

In response to the question of their understanding of sustainability most respondents used single remarks like durability, permanent and long-term conservation, conservation, good and cheap materials, good, cheap and durable materials, another response was save paper to conserve forests and one respondent's response was using renewable and biodegradable materials and recycling. One respondent's comment was environment friendly materials, harvesting solar energy, rain water harvesting, waste water recycling and reducing heat loss and heat gain. Based on the respondent's response on their understanding of sustainability, the responses have been categorized into 4 more general wider areas, which are durability, conservation, cost and re-use/recycling. The responses are shown in the table 4.8 given in the following page.

What do you understand by sustainability?

Durability	Conservation	Low Cost of Materials	Re-use/Recycling
7	4	2	2

Table 4.8

Structured Interview Survey Data: This data is based on the 10-interview respondents responses

Satisfaction levels

General satisfaction: In response to the question on whether they were happy with their homes, most responses were- to an extent and these have been slotted under moderately satisfied responses. The responses are shown in the table 4.9 given below.

Are you happy with your home?

Yes	Moderately Satisfied Responses	No
0	10	0

Table 4.9

Participation

In response to the question on participation the responses were no and the results are shown in the table 4.10 given below.

Have you participated in either the planning or construction of your house?

Yes	No
0	10

Table 4.10

Recycling

In response to the question on waste recycling all respondents said they recycled household waste by giving it to the rag collectors who sorted and sometimes recycled them into other household goods. The respondents mentioned recycling of old newspapers, plastic waste, bottles and other household waste in exchange for money of other household goods like plastic buckets and pans. According to them, the rag pickers locally known as kabariwalas come to their doorstep hence making recycling practically effortless. Their inputs suggest that recycling is an inherent part of the Indian urban culture. However there is no evidence of recycling in construction and according to the inputs from the DDA official interviewed

the materials used in most units at present are not designed for recycling except for wood. The results are given in the table 4.11 given below.

Do you recycle waste?

Yes	No
10	0

Table 4.11

Complaints

In response to the question on any complaints the ten respondents mainly talked about inadequacy of space, deteriorating quality of the structures, regular power failures, indoor heat during summer months, noise pollution, lack of adequate parking space and insecurity due to rise in crime in the locality and few cases of burglary and even murder (a consequence of poverty and social disparity in other settlements in the area).

Site Observation Data: This development has been provided with a small shopping complex, there is also a large hospice near this development and services like shops and green spaces are walking distance to most housing units. Hoverer since this development is located in the city fringes and main commercial and office blocks are more centrally located all interview respondents said they commuted to these places by car. Despite the option of public transport like buses, rickshaws and taxis the respondents choose to drive to work because of convenience. According to one respondent mass transport systems should be made more accessible and well connected to the suburban parts as well. Personal experience during site visits also show that public transport is available in the form of buses, taxis and scooters- however taxis and scooters are expensive and not always available and buses are mostly packed at all times thus uncomfortable for long distance travelling. Secondary data official reports collected support this problem of inconvenience in public transport hence in New Delhi the Government has started the metro underground rail in most parts of Delhi since the year 2004, but it has yet to connect the whole of Delhi, which has now grown horizontally touching the fringes of the neighbouring states of Haryana and Uttar Pradesh (Delhi, A Fact Sheet).

In this case study the respondents were moderately satisfied with the general condition of their shelter units, however most respondents expressed dissatisfaction over the services provided. Since the planning and execution is carried out by the public sector and user

participation is absent. The priority area thus would be to incorporate and encourage more user participation resulting in more user inputs on their needs, expectations and preferences. This could be supported with the aid of user inputs by conducting surveys having opinion boards, and workshop presentations among prospective buyer on the preferences and acceptance levels. In addition since the level of user awareness to shelter aspects of sustainability and efficiency among the respondents of this study was low user participation would also generate more awareness. In addition to integration of user participation, existing networks like the informal network of waste collectors should also be integrated in an organised way into the housing infrastructure. According to this study the areas that needs to be addressed are integration of user participation and existing systems already a part of the Indian culture and tradition and more awareness generation.

Economic Aspects of Shelter: This section will look at the factors affecting shelter accessibility and affordability such as shelter cost and budget. The question on budget was incorporated into the questionnaire survey in order to evaluate general user perception on how important a role budget plays on terms of how much people have and what they expect with that budget in order to further understand why despite affordable, cost-effective options good quality shelter is still considered inaccessible.

Economic Hypotheses *Basic housing in urban areas remains inaccessible to the masses due to high shelter costs and budget constraints of the households and public sector shelter providers.*

Questionnaire survey data:

Impact of budget

In response to the question on whether budget affected quality, planning and choice of materials used all 15 respondents yes and is shown in table 4.12 in the following page. This means that a lot people are under mindset that budget influences the type of shelter acquired and although this is true to a certain extent, there are alternative options. For instance, according to data collected in the literature review more cost does not necessarily mean better quality. There are many options in the market, which are not only more affordable, but of similarly good quality as well. Hence due to mindset and poor number of predecessors the public, the planners and builders today are not using most cost-effective

technologies in the market. People are yet to overlook the stigma attached to low cost technology.

Do you think budget affects the quality and choice of materials?

Yes	No
15	0

Table 4.12

Interview survey data:

Impact of budget

In response to the question on whether budget effected quality, planning and choice of materials used all 10-interview respondents responded yes. The results are shown in the table 4.13 given below.

Do you think budget affects the quality and choice of materials?

Yes	No
10	0

Table 4.13

Hence the interview respondents' responses also indicate that most people do feel that budget influences the quality of shelter achieved. In response to the question on how the respondents felt about the use of alternative building materials and building with mud products, all respondents didn't respond enthusiastically. Some remarked on preference to conventional brick and concrete, one respondent said traditional materials were becoming more expensive than conventional materials as the knowledge to make then is dying. One respondent said that conventional materials and mechanical systems were preferred as they gave quick results and required less labour, one said conventional materials are time tested and implemented. This shows that most of the respondents have preference for presently used materials like brick and concrete and wouldn't prefer going back to age old traditional nor materials being developed as alternative options.

External Aid

In response to the question on whether they felt that shelter would be affordable to them without external help, all respondents said no and some added comments like 'took bank loans' and 'put in life savings' into their house investment.

In response to the question on whether they felt that the investment on their house would be higher or lower than the domestic energy cost in a period of ten year, all the interview respondents felt house investment cost would be higher and shown in table 4.14 below.

Do you think that the investment on the house would be higher or lower than the cost of domestic energy used in a period of ten year?

Higher	Lower
10	0

Table 4.14

Secondary data collected during the site visit to the DDA office building:

The public sector housing has been the choice for the MIG till now due to reasons of affordability as compared to the private developments. However despite being a public development and despite being mass executed the cost of these flats are high and therefore schemes such as instalment payment schemes have been introduced to make shelter more affordable to the MIG households. The private sector housing developments being more expensive are catered mainly for the higher MIG and the HIG section of the community. However this trend is gradually changing with the private sector now catering for the MIG households as well.

According to HUDCO official report, MIG belong to the salary bracket of Rupees 7,500-10,000 (£125 approximately) (HUDCO, 1998). Thus presuming that two members are earning; they earn around Rupees 15,000- 20,000 (£250 approximately) per month and around Rupees 2,40,000 (£3000 approximately) annually and (£1500) if only one family member is earning. In the 1980's when this program was initiated most of these units ranged between Rupees 100000- 300000 (£1250-3750) however present costs of these flats range from Rupees 30,00,000-40,00,000 approximately (£ 50000 approximately) excluding the furnishings and other costs. According to comparisons with HUDCO's MIG salary bracket, this costs price turns out to be more than ten years of their annual income and more than twenty years if only one member is earning.

Additional information:

In addition most public houses are given on a draw basis, which means most households end up either waiting for their turn or resorting to other options like private developments far away from the city fringes. The questionnaires and interviews conducted also suggest that the respondents are aware of energy conservation but mainly limit their energy use for the reason of savings on electricity bills. Whereas attitude of households living in houses allotted by the government where all services are free or subsidised is that of less concern. This is based on three interviews were conducted of respondents living in government allocated houses where all three respondents agreed that they were less careful in turning off lights and fans when leaving the room.

This study shows that cost of these units were much less in the eighties when the houses were first put into the market. However the present cost of a dwelling unit is high compared to the spending capacity of most MIG households. Therefore present annual incomes most families cannot afford to buy these houses unless they take bank loans, payments are made in instalment and the costs are reduced. Schemes such as instalment payment have proven to make shelter more accessible. However use of cost-effective technologies and materials, which are widely available today but not used in most housing schemes this housing one would probably reduce shelter costs and make shelter more affordable. Conventional materials adopted in this housing are energy intensive as well as compared on alternative options developed through research. Therefore shelter choices are neither being able to address the short-term needs of providing basic affordable shelter but are also likely to have long-term impacts on the environment.

Environmental Aspects of Shelter: In this section the investigations will be carried on aspects and issues likely to affect urban shelter comfort such as density, space and energy use suggested by the respondents. The aims to help determine if respondents are satisfied or dissatisfied with shelter in terms of general comfort. In addition their inputs will contribute towards a better understanding of the comfort needs and their awareness levels with respects to energy issues.

Environmental Hypotheses *General comfort conditions are unsatisfactory in urban housing.*

Questionnaire survey data:

Density, space and comfort

In response to the question of what they felt affected comfort most of the questionnaire respondents felt that space affected comfort and some respondents felt that D.U/ Hectare was too high. Answers suggesting spatial needs and density have been slotted under adequate space, answers such as design and planning have been put under house plan. One respondent wrote about heat gains and heat loss. According to them these are areas that need attention and hence improvement in these areas would improve present shelter conditions. The results are shown in the table 4.15 below.

What do you think affects Comfort?

Adequate Space	House Plan	Reduced heat loss/heat gain
12	3	1

Table 4.15

Energy use and comfort

In response to the question on energy use and energy conservation in shelter, most respondent were aware of energy conservation and agreed that energy conservation should be an important aspect of shelter design. However only one respondent commented in detail on use of solar energy in households, use of environment friendly materials, rain water harvesting and wastewater recycling. The results are shown in the table 4.16 given below.

Do you think energy conservation is an important consideration in design?

Yes	No
15	0

Table 4.16

In response to the question on the issues concerning energy and housing at present most of the respondents expressed concern about regular power cuts in electricity supply and commented on discomfort due regular power cuts. The results are shown in the table 4.17 given in the following page.

What are the issues in energy and housing today?

Power shortage/power cuts	Cost	Wastage
12	2	1

Table 4.17

In response to the question whether the residents felt that the houses today were built considering the climatic conditions most residents ticked no. The results are shown in the table 4.18 given below.

Do you think your home is suitable for the type of climate it is constructed for?

Yes	No
2	13

Table 4.18

Interview survey data:

Density, space and comfort

This survey indicates most respondents associate shelter comfort with space adequacy. Some of the interviewees when questioned on space have expressed a need provisions for extension facilities when need arises and means are available. In response to the question on what they felt affected comfort, most of the interview respondents also gave importance to space and they felt they space inadequacy would lead to discomfort. The results are shown in the table 4.19 given below.

What do you think affects Comfort?

Space	Other
10	0

Table 4.19

Energy use and comfort

In response to the question on the issues concerning energy use and housing today a higher number of the respondents commented on the power shortage and therefore regular power cuts. The results are shown in the table 4.20 given in the following page.

What are the issues in energy and housing today?

Power shortage/power cuts	Cost
7	3

Table 4.20

Site survey observations and secondary data collected during the survey:

Description of the site

New Delhi has extreme temperatures, summer months are extremely hot and winters extremely cold. Winter lasts for 4 months from November to mid February, while summer lasts for 8 months in a year from March to September. Observations made during site visits surveys indicate that Vasant Vihar housing development is located in the outskirts in an arid rocky kind of terrain with very less vegetation. Most of the shrubs in and around this area have thorny foliage similar to those found in hot and dry regions. The planners have integrated green spaces into the planning of the development in the form of parks but lack adequate shade and is shown figure 4.5 given below. Green spaces provided are rarely seen used by the households' during the site visits.

Figure 4.5

Density, space and comfort:

This development has a density of 175 dwelling unit/hectare, and one dwelling unit per 5 persons approximately (data from the DDA official interview). Interview data also suggest that most respondents have a family of 4 to 5 members. According to literature review data densities of about 8-10 metres square per person are generally regarded as being

satisfactory. Since each flat is 88.68sq metres space for each member is more than sufficient for comfort.

However observations made during the site survey it is evident that many households have added extensions to their dwelling units by covering up the balconies and extending the living areas into the balconies and some such units are shown in figures 4.6 and 4.7 given below and in the following pages. Although there is no provision for incremental growth wherever possible people made extensions to their living quarters. These extensions are made despite building regulations, which stop them from doing so. Suggesting that most households prefer to have more space where possible and therefore do not mind to spend a bit more, even break regulations to create more space. (In the traditional vernacular houses the dwelling units were mostly sprawled out around a central courtyard with a lot of space for social activities and interaction. Indian culture is based on joint families and some respondent families still follow this culture thus high-density living is still common in urban households).

Figure 4.6

Figure 4.7

Energy use and comfort

Site observations indicate low ceiling height and the absence of ventilators above the windows otherwise common in hot dry places to promote ventilation. Structural elements like overhangs over windows and balconies are common to most houses, which have been added by the households to provide additional shading to the balconies. Materials like fibreglass have been fitted on top of open to sky balconies and back yards for shade as can be seen in figure 4.8 given below.

Figure 4.8

Apart from ceiling fans site observations also show the use of air conditioners by most houses shown in the figure 4.9 given in the following page. This suggests dependence on mechanical systems especially during summer to improve indoor temperatures. One drawback of having air-conditioners fitted into the window box is that it closes the window opening and on cooler days natural ventilation through windows cannot be taken advantage

of. Also frequent use of air-conditioning is likely to increase running energy costs of a household.

Figure 4.9

Heavy dependence on mechanical coolers and air-conditioners also means heavy power consumption. Literature review findings suggest that the production of power is not keeping pace with the consumption levels. The power supply for the year 2002 indicates energy deficit of 7.5% and peak deficit of 12.6%. There is a gap of 11.6 % between demand and supply. Peak demands have risen from 60981MV in 1995-96 to 74216 MV in 2000-2001. Renewable energy is at initial stages and at present contributes about 1600MW of energy in 1999-2000 and peak demand in 1999-2000 was 72669 MV with peak demand of 63691 and deficit of 8979 MV (Annual Report, Ministry of Power, 2000-2001) (Annual Report, Ministry of Non-Conventional Energy Sources, 1999-2000). At present coal is the largest contributor to the energy sector and around 70% of the coal produced is consumed by the power sector. (www.teriin.org).

The study of this MIG development suggests that a higher number of respondents are dependent on mechanical systems in order to improve indoor temperatures. Also commonly used passive element like adequate shading, ventilators have not been integrated in this development. Factors such as effect of colour of the building material used on the internal temperatures have not been considered. The residents have also complained of regular power failures leading to discomfort, which could have been reduced if appropriate passive planning systems had been adopted.

Political Aspects of Shelter: This section will gauge user awareness of shelter policies and schemes LIG/EWS in order to access the level of exposure to shelter schemes and the interaction between the respondents and government shelter body representatives.

Political Hypotheses *Housing policies and programs are based on public body understanding of user needs and not on real user inputs.*

Questionnaire survey data:

User awareness to political targets and schemes

In response to the question on their awareness to any political targets for housing most respondents wrote no and is shown in the table 4.21 given below.

Are you aware of any political targets for housing?

Yes	No
2	13

Table 4.21

According to the questionnaire survey most respondents are not aware of any political targets concerning shelter. This lack of knowledge suggests a lack of involvement or interaction between government housing bodies and the respondents of the households on policies and schemes that concern them. This is also a suggestion of either a lack of interest, exposure and easy accessibility to schemes and policies.

Interview survey data:

User awareness to political targets and schemes

To the question on awareness to political targets all the respondents response was no and the results are shown in the table 4.22 given below.

Are you aware of any political targets for housing?

Yes	No
0	10

Table 4.22

However in response to the question on awareness to bank schemes and housing loans most of the older respondents were aware. In response to the interview question on whether they participated in the planning or development of their shelter all the respondents said no. Hence respondents' inputs suggest that users are not involved in either the macro level of

shelter programs nor at the micro level of planning or construction of their units. The interview with the DDA official also suggests that the planning is solely done by their department based on mass construction and only in some cases old surveys conducted are consulted. This study suggests the absence of real perspective on user needs and priorities and public housing developments based on what the bureaucrats and planners understand of user needs in this public MIG housing.

This study supports the hypotheses, this MIG development all the planning and execution was done by the DDA public sector planners and based on their interpretation of user needs from shelter. Although user participation has been recognised as by the government it is absent in this development. Also the respondents lacked awareness on policies and schemes, which not only indicates lack of interest but lack of accessibility to Government programmes. In this development there is a need for adoption of more user inspired shelter policies based on proper survey of user needs and user participation. Also easy public access to all government polices and transparency of budgets allocated towards shelter and other departments should be adopted.

Technological Aspects of Shelter: this section looks are various materials used and user attitudes towards them.

Technological Hypotheses *Despite efficient alternative building material options present choices adopted are not cost, resource and energy efficient.*

Questionnaire survey data:

User Preference

In response to the question on what the respondents thought were popular materials most respondents response was cement and brick, with two respondents also adding steel and wood. The results are shown in the table 4.23 given below.

What do you think is the most popular and convenient material?

Cement	Brick	RCC	Steel	Wood
11	15	1	1	1

Table 4.23

(This question was open ended in order to receive not only user inputs but also to gauge their awareness to building materials).

All 15 questionnaire respondents agreed that traditional materials were replacing materials like brick and cement and had a positive remarks towards present conventional materials used the results are shown in the table 4.24 below.

Do you think that modern materials are replacing age-old materials?

Yes	No
15	0

Table 4.24

Most responses such as more durability, permanence, time effective, less labour, cheap, easy to procure, lasting, longer lifespan, flexible, easy to work with and security/safety. One respondent gave a negative remark, which was high cost. The respondents' remarks have been categorised into positive and negative remarks and are shown in 4.25 given below.

What do you think are the advantaged and disadvantages of this change?

Positive Remarks	Negative Remarks
14	1

Table 4.25

In response to the open ended question on how they felt about the use of materials like mud, most respondents gave negative responses such as unsafe, not durable, not permanent, expensive, low life span, maintenance hic-ups, unfeasible materials for larger scale constructions, do not appreciate and not good. The respondents' remarks have been categorised into positive and negative remarks and the results are given in the table 4.26 given below.

How do you feel about using local materials like mud?

Positive Remarks	Negative Remarks
0	15

Table 4.26

Interview survey data

In response to their satisfaction with the building materials used in their house all respondents said yes. The results are shown in the table 4.27 given below. In response to the question on the awareness to alternative building materials all the respondents response was no. One respondent said traditional materials were becoming more expensive than conventional materials as the knowledge to make and technology to build them is dying, according another respondent conventional building materials were cheaper than the traditional local materials available and thus he preferred conventional materials (all the other comments are given in the appendix section).

Are you satisfied with the building materials used?

Yes	No
10	0

Table 4.27

Site survey observation and secondary data collected during the site visits:

In this development the main material used is pre-fabricated concrete block. According to the DDA official pre-fabricated concrete blocks have been used due to the need for a large number of housing units in a shorter time period. Pre-fabricated concrete blocks are faster to build as compared to other popular building materials used by the industry. Prefabricated concrete blocks have been selected for lightness in weight and fast and easy to build qualities. The average size of the concrete blocks used is 400mm x 300mm x 200mm or. 390mm x 300mm x 190mm and the compressive strength is 40kg/cm – 75kg/cm (DDA official).

Given below are the different materials used for construction- none of the materials used below have been recycled:

For Doors: Timber, Pressed steel blocks, Angel iron

For Windows: Block Board shutters

For Walls: Concrete Blocks

For Roof: RCC slabs

For Floor: Terrazzo

For Ceiling: Plaster, Paint

This study suggests that higher numbers of the respondents are satisfied with the materials used. A larger percentage of the respondents were also more aware of and preferred conventional materials to traditional and alternative materials. The pre-fabricated concrete blocks used in these houses are faster to build as compared to other popular building materials there are other materials like soil blocks, local tiles, micro concrete, bamboo concrete and other locally produced material, which are more likely to be energy effective. Also production units for popular materials like brick and concrete are out dated and inefficient resulting is pollution and higher fuel consumption. Even though most conventional materials are energy and cost intensive the respondents preferred them to more effective appropriate alternative technologies. Hence according to the responses of the respondents, satisfaction levels are dependent on the use of preferred materials and user preference is dependent on level of awareness, familiarity, accessibility and exposure to the product and proper marketing of the product which offers them what they look for such as durability, strength and permanence.

Therefore there is need for large-scale adoption of cost effective technologies available by public and private construction sector. Work must also be done to generate awareness and promote local and alternative materials to change existing attitudes towards alternative and cost effective technology. Simultaneously since conventional materials are still a preference the production units should be made more efficient and efficient units should be supported through subsidies and tax rebates.

4.5.5 Summary:

Given below are advantageous and disadvantageous aspects of this housing:

Advantages:

- The option of instalment payment scheme was made avaiable to the buyers making shelter more affordable.
- There is an informal network of rag collectors collecting domestic waste from these households.
- The time taken to construct these units are lesser due to the use of pre-fabricated concrete blocks for constrcution.

Disadvantages:

- User participation is absent.
- The units have no provision for incremental growth however despite that some households' have built additional units.
- Passive systems like sunshades and ventiltors have not been effectively integrated in these units.

- A larger number of the respondents are dependent on mechanical systems for mainly cooling materials.
- The materials used are not energy efficeint compared to other alternative options available.
- The respondents show preference to cost and energy intensive conventional building materials like brick and concrete.

This development has been planned and executed by the public sector and user participation in the planning process and execution seemed to be absent. The absence of any kind interaction between the user and the developer's results in gaps of knowledge on user shelter need and preferences, which can be easily achieved through surveys conducted among prospective buyers. As a result of which the areas needing attention can be effectively addressed before the households adopt more drastic measures. For instance, in this case study most respondents expressed the need for additional space, which was dealt by building additional rooms. Another area of dissatisfaction was indoor thermal comfort effectively addressed by the respondents with the use mechanical systems. However although a large percentage of the respondents were dependent on mechanical systems for comfort, due to regular domestic power failures mechanical systems were not always dependable resulting in unwanted discomfort. Integration of more passive systems would promote energy efficiency and also naturally improve shelter conditions especially during power failure emergencies. Use of passive cooling options in combination with mechanical systems would also reduce the running energy use of a household.

At present costs, these units are not affordable to the income group they have been catered for without the support of loans and instalment payment schemes. Adopting more cost-effective technology and materials readily available in the market, could perhaps reduce the overall cost of construction and help reduce the selling cost of the units. In this development concrete block is the main building material, which according to the DDA planner interviewed was adopted because of its properties such as easy execution, time efficiency. These blocks are effective in terms of durability but the residents' complained about the quality of the structure.

In the area of recycling informal recycling of domestic waste is evident among households carried out by rag collectors who go from household to household collecting waste like paper, metal, glass and plastic in exchange for cash or kind (mostly recycled goods). However there is no evidence of recycling construction waste. This study indicates that respondents of this shelter are moderately satisfied, however unsustainable in terms of

inefficiencies such as growing dependence on mechanical systems and use of energy intensive building materials.

4.6 Stage A Case Study II – Housing Developments in Kerela by Costford

4.6.1 Introduction: Stage A Case Study II is a study of low income group (LIG) shelter units implemented by Costford (Centre of Science and Technology for Rural Development) in Trivandrum capital city of Kerela. Costford not only promote and develop cost effective technology they also implement them in LIG and MIG developments in Kerela. Site visits were carried out in the month of September 2000. Regular site visits were conducted during this month and a questionnaire survey was conducted by carrying out interviews of 6 LIG residents during the site surveys (using questionnaire set A and set A interview questions). An interview was also conducted of a Costford member, which has been used for the purpose of this study. Along with this primary data, the data collected from the Costford institute publishing's has been extensively used and books published by Laurie Baker collected during the site visit to the COSTFORD institute have also been used as secondary data in order to back up this study.

Design and Execution: Costford, Kerela

Background on Costford: Centre of Science and Technology for Rural Development is a non-profit making voluntary organisation of scientists, technologists, educationalists, professional and social workers. This organisation endeavours to empower and enable the poor and weaker sections of the society. To improve their living conditions by the application of appropriate and people-friendly technologies adopting participatory, democratic, transparent and gender sensitive processes in Kerela. United Nations has recommended a rate of 10 houses per thousand population to attain self sufficiency in housing within a reasonable period of 10-15 years and Kerela state has been able to achieve a house construction rate of 5 to 6 per thousand population due to its innovative shelter programs (K.Thomas Poulose, 1988). Costford is an organisation mainly involved in developing and implementing alternative building technologies that aid in reducing the cost of construction. Costford has also been concentrating on areas such as rural sanitation, renewable sources of energy, rural and urban housing using only cost reducing techniques and water management at the micro level. The objectives of costford are aimed at tackling the problems of the poor with the use of do-it-yourself simple methods, which are within

the reach of the poor and also generate employment by using traditional materials and ideas in a contemporary and scientific manner. Costford also deciphers technological know-how by teaching people on the spot on how to improve their living and working conditions during making and construction. Costford also tries to involve professionals and technicians in its training programmes so that they can see for themselves the priorities and actual requirements of the people.

3.6.2 Location: These houses are situated in the outskirts of Trivandrum, capital of Kerela in the southern part of India and most houses are still in the construction stage where the residents are also involved in self-help activities. The climate of Kerela is warm and humid with heavy rainfall and an average maximum temperature of 31 .7 degrees Centigrade and minimum of 23.3 degrees Centigrade. This development is a cluster settlement located in the fringes of the Trivandrum city. The site is situated on an undulated site.

3.6.3 Procedure: Regular site visits were conducted to this cluster of houses in order to carry out the questionnaire along with structured interview surveys and site observations. Most of the residents were not available during the site visits as most worked during the day, the 6 participating respondents present in the site involved in self-help activities in the construction of their units. One main problem encountered during the interviews was the language barrier as most of the people from this group only spoke the local dialect called Malayalam and also low literacy rate among this group. Thus this study has conducted with the help of a local guide and interpreter. The data collected has been presented in tables, and photographs taken during the site surveys have also been used to support this study. Site visits were also made to the Costford institute, during which the interview with one member was carried out and additional written data in the form of Costford publishing's were also collected.

3.6.4 Analysis: In this section of the study the social, economic, environmental, political and technological aspects of these LIG shelter developments will be investigated with the help of on site observations and questionnaire surveys and structured interview survey data. In addition some of their inputs, which have not been included in this discussion but are given in the appendix sections have contributed to a better understanding of the needs and preferences of this category.

Details of a house (One unit): the area of each house is approximately 22.5metres square, these are mostly single storey houses or ground plus one with other facilities like sit outs as can be seen in the figure 4.10 given below. Each house has a common room with kitchen, sleeping place and a toilet and the building materials used are exposed brickwork with cement fillers, thus these houses are maintenance free, as they do not require any wall paint and repainting. However some residents complained about the accumulation of dust on the exposed walls. Most of the houses are still in the stages of being constructed and some of the future occupiers are residing here and while participating in construction of their units.

Figure 4.10

The roof style used is sloping roof characteristic of this state (due to heavy rains sloping roof is used in order to quickly shed heavy rain, it also protects the walls from getting damp and provides shade at the same time protecting the indoors from the heat). The windows have metal grills, which lets in light and fresh air into the rooms. According to respondents comments problem with grilled windows is the entry of mosquitoes and other insects.

Social Aspects in Shelter: In this section the investigations will be carried concerning the general condition of this housing LIG housing cluster by gauging the respondents satisfaction levels with their shelter units, satisfaction concerning services provided, inputs of their requirements concerning shelter comfort and whether these needs have been considered in the planning of their house. In addition their inputs on location preferences, demand for a particular house type, awareness levels have contributed to a better understanding of the needs and preferences of this category.

Social Hypotheses Urban housing conditions do not satisfy the general housing needs of the dweller.

Questionnaire survey data:

In response to the question on what they thought were the major issues concerning shelter from the options given all the respondents said cost, which has been slotted under the economical aspect. The results are given in the table 4.28 given below.

What do you think are the major issues affecting shelter today?

Social	Economical	Environmental	Technological
0	6	0	0

Table 4.28

Satisfaction levels of the 6 respondents

General satisfaction: In response to the question of general satisfaction from their shelter units, most respondents' responses were yes. These responses suggest that the respondents are quite content with their dwelling units and the results are shown in the table 4.29 given below.

Are you satisfied with your home?

Yes	Moderately Satisfied Responses	No
6	0	0

Table 4.29

Service network: In response to the question on satisfaction on the provision of services, the respondents expressed dissatisfaction with the services they get and the results are the shown in the table 4.30 given below.

Are you satisfied with the service networks provided?

Yes	Moderately Satisfied Responses	No
0	0	6

Table 4.30

Incorporation of their needs and preferences in design and planning of their home

In response to the question of whether their needs and preferences were taken into consideration in design and planning of their home all the respondents responses were 'yes'. Although Costford executes these houses the respondents can participate in the

construction thus supporting user-participation. The results are shown in the table 4.31 given below.

Do you think people's needs are taken into consideration in planning and design of their home?

Yes	No
6	0

Table 4.31

In response to the question on demand for a particular type of housing from the choice of high rise and low rise all the six respondents opted for the low rise. The results are shown in table 4.32 given below.

Do you think there is a demand for a particular type of housing these days?

High Rise	Low Rise
0	6

Table 4.32

Preference in location: In response to the question on choice of location, all the respondents said they preferred to live close to area where they work and close to work opportunities. All these responses have been slotted together under 'near work opportunities' and the results are shown in the table 4.33 given below.

Would you prefer to live in the city or the suburb? Other?

City and suburb: Near work opportunities
6

Table 4.33

User Level of Awareness

The responses received for the question on how to improve solar gains, shading, cooling, ventilation and lighting the 6 respondents commented on the use of windows and ventilators for ventilation and natural lighting and shading devices for protection from the sun and cooling. Their responses have been slotted under their respective comments and are shown in the table 4.34 given in the following page.

Do you have any idea on how to improve solar gains, shading, cooling, ventilation and lighting?

Windows for ventilation/sunlight	Overhangs for shading/cooling
6	6

Table 4.34

Sustainability

The respondents did not have any comments on sustainability as difficulty was encountered translating the meaning in the local language.

Structured Interview Survey Data: Since the questionnaire survey was carried out though interviews of the respondents, additional structured interview questions (set A) have also been used during these interviews. The following data was collected from the interview questions.

Participation

In response to the question on the involvement in the planning and construction of their house all responded 'yes' and the results are shown in the table 4.35 given below.

Have you participated in either the planning or construction of your house?

Yes	No
6	0

Table 4.35

In addition the interview respondents when questioned on waste recycling all respondents responded yes. The respondents said they sold household waste to local rag collectors and is shown is table 4.36 given below.

Do you recycle waste?

	Yes	No
6 Questionnaires	6	0

Table 4.36

Complaints

In response to the question of any complaints the six respondents said more space with comments like more children need for bigger space, growing family needs. Three respondents complained of dust sticking to the exposed walls and few complained on mosquitoes and entering through the grilled windows.

The respondents of this study were generally satisfied with the condition of their homes however the respondents were not satisfied with the service networks provided. The units were built according to individual family needs and therefore the units although of the same area have different plans. However the level of awareness among the respondents were low. Hence among these respondents as well gradual awareness has to be generated in areas, which will benefit them as well as the environment.

Economic Aspects in Shelter: In this section the investigations will be carried concerning cost and affordability of shelter impact of budget on shelter quality by gauging the respondents of this LIG housing cluster.

Economic Hypotheses *Basic housing in urban areas remains inaccessible to the masses due to high shelter costs and budget constraints of the households and public sectors shelter providers.*

Questionnaire and interview survey data:

Impact of budget

In response to the question on whether budget effected quality, planning and choice of materials used all 6 respondents said yes and is shown in the table 4.37 given in the following page. Among this group as well people felt that budget effected quality and choice of materials implying that they felt with their budget they could only afford a certain quality of material most probably a poor, less finished shelter. This true to a certain extent with respect to bigger more lavish units but is not necessarily true in terms of quality and durability.

Do you think budget affects the quality and choice of materials?

Yes	No
6	0

Table 4.37

External Aid

All respondents said shelter would not be affordable without assistance. They had to put in savings along with loans from bank and relatives in addition to assistance from Costford.
In response to the question whether they felt that the investment on their house would be higher or lower than the cost of household energy used in a period of ten year, all the interview respondents felt it would be higher.

Secondary data collected during the site visit and a data from the interview of the Costford member:

Based on the information gathered from the Costford member and the written data, these units are good examples of cost effective and affordable LG/EWS units built with the use of techniques and material that reduce the construction costs and become affordable to people of this income group. Due the use of local materials and resources promoting local economy the units also reduce the cost and energy put into long distance transport thereby reducing the total embodied energy of the unit.
According to a HUDCO official report this category falls under the annual salary category falling within Rupees 4,500 per month (£ 56 approximately) and an annual income of £ 54,000 (£675 approximately), which is the income of an individual or two individuals per household. Assuming a minimum cost for a moderate house being Rupees 40,000 (Costford Publications) and considering monthly expenditures on food, shelter, clothing and education almost nothing is left and even minimum costing units are beyond affordable standards. Therefore despite minimum costs people still would need to invest more than 20 years of their savings to be able to afford a house.

Environmental Aspects in Shelter: In this section the investigations will be carried concerning comfort and what according to respondents affects comfort. The questions are open-ended and by gauging the respondents on issues concerning shelter comfort and based on their comments the following discussions and analysis have been carried out.

Environmental Hypotheses *General comfort conditions are unsatisfactory in urban housing.*

Questionnaire survey data:

Comments on density, space affecting indoor comfort

In response to the question on what according to them would affect indoor comfort all the 6 respondents commented on the need for adequate space indoor, size of rooms and the provision to add more rooms when the need arose and means were available. Some respondents also commented on the availability of clean drinking water as an important aspect of a house. The results are shown in the table 4.38 given below.

What do you think affects Comfort?

Space	Access to clean water
6	5

Table 4.38

(Literature review suggests that water is an important aspect of a person's life in terms of heath and hygiene, which is often taken for, granted by most of us. However in developing countries especially among the poorer section where access to water is poor, water dictates their day-to-day activities and time put into collecting water).

Energy use and comfort

In response to the question on energy use and energy conservation in shelter, most respondents of this group felt that energy conservation was important and some commented on the aspect of reducing energy costs by minimising household energy use. The results are shown in the table 4.39 given below.

Do you think energy conservation is an important consideration in design?

Yes	No
6	0

Table 4.39

In response to the question on the issues concerning energy and housing at present most of the respondents commented on electricity costs, power cuts and lack of access to supply in their previous informal houses. The results are shown in the figure 4.40.

What are the issues in energy and housing today?

High cost	Access to electricity services
5	2

Table 4.40

In response to the question whether the residents felt that the houses today were built considering the climatic conditions the residents commented yes. Some commented that their units were comfortable and airy. None of the respondents in these cluster houses own air-conditioners, due to cost factors as well. Three of the six respondents however said they owned table fans. This indicated that the dependence on mechanical systems to improve indoor comfort in low among the 6 respondents. The results are shown in the table 4.41 below. Due to humidity proper ventilation and use of fans for air circulation are an important element of housing in Kerela.

Do you think your home is suitable for the type of climate it is constructed for?

Yes	No
6	0

Table 4.41

In response to the question whether they felt that the investment on shelter would be higher or lower than the cost of household energy used in a period of ten year, all the respondents felt it would be higher.

Site survey observations and secondary data collected during the survey:

Density, space and comfort:

According to information given by the respondents most families here are large with 4-6 family members in minimum and thus these houses accommodate high-density living in the space available. Based on site observations and additional inputs of the respondents each unit is around is 22.5 sq metres with floor to ceiling height of 3 metres and some units with higher ceiling for extra loft space. If for instance a family of 5 persons is considered each persons gets a space of 4.5 metres square, which is considered inadequate according to general standards. Most residents of these settlements make maximum use of space available by having sleeping, working and eating quarters in the same space (probably since they connot afford the costs of additional space). The concept of extended families also

exists in this community and when the sons get married they carry on living with the parents at least until they can afford one of their own.

Climatic suitability

Site observations indicate low ceiling height. The units have sloping roof for protection during heavy monsoons and ample openings have been provided to promote ventilation. Figures 4.11 below and 4.12 given below show examples of the cluster houses with sloping roof.

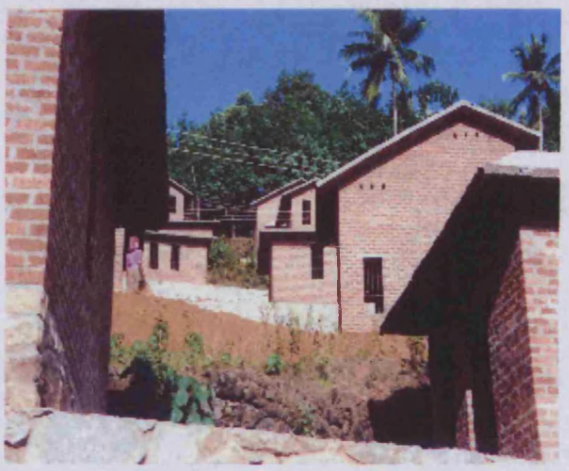


Figure 4.11

Figure 4.12

In this study the respondents were satisfied with the comfort condition of their homes. The households live energy efficient lifestyles as well, since the households do not have air-conditioners. Also they cannot afford the investment and operation cost of these mechanical systems. Observations during the site visits show that design aspects such as sloping roof

and ventilation have also been incorporated, along with different plans and shapes catering to the needs of each family. However the main building material used, which is brick, is locally produced in inefficient production kilns. Most present production units are not up to date and therefore inefficient, they consume more energy in the form of fossil fuels. Therefore more effort and funds need to be directed towards providing new more efficient production units.

Political Aspects in Shelter: This section will gauge user awareness of shelter policies and schemes LIG/EWS in order to access the level of exposure to shelter schemes and the interaction between the respondents and government shelter body representatives.

Political Hypotheses *Housing policies and programs are based public body understanding of user needs and not on real user inputs.*

Questionnaire survey data:

User awareness to political targets and schemes

The 6 respondents of this LIG cluster were not aware of any political targets concerning shelter suggesting a gap in knowledge concerning schemes and policies that concern them. One respondent commented on unfulfilled promises from different parties during election campaign propagandas on employment generation, shelter and service subsidies. As already discussed in case study 1 this is may be due lack of easy access to such information and absence of public and local authority interaction. The communication gap between the government and the public is also evident in low public awareness to government schemes and targets. The results are shown in the table 4.42 given below.

Are you aware of any political targets for housing?

Yes	No
0	6

Table 4.42

Site observation data and secondary written data (same as case study one data used):

The literature review on political aspect of shelter indicates that there are many Government schemes and targets especially for the LIG and the EWS housing and

providing basic housing for all has become important over the years. Every five years, housing programs and targets are set in order to address shelter needs, however many targets remain only targets compiled in files and are never achieved (based on the review of the Planning Commission Report of 1999-2000). Government schemes like the Delhi Development Authority's scheme of model condominium for slum dwellers incorporating flexibility to accommodate each families needs, affordability and use of cost-effective technologies and self-help opportunities which would encourage greater involvement. However these schemes have not been successfully implemented. The Government also promotes R&D based alternative technologies for constructions lacks successful implementation and dissemination of these technologies and resources on a larger scale. However more NGO based initiatives for LIG/EWS shelter have proved to be more successful like this LIG/EWS housing cluster and other similar shelter units executed by Costford but in this case has been limited to the state of Kerela. The success of Costford in Kerela state suggests that the involvement of decentralised state based non-governmental organisations is more effective in implementation and dissemination of efficient alternative technologies at the grassroots level.

Over the years the shelter policies have merely looked at EWS/LIG shelter as a mass product to be delivered to the masses in the midst of time and resource constraints. Hence in order to cut down costs and increase the numbers often the quality is compromised. Little attention has been given to the requirement of the group for whom these units are mass-produced. This study shows quality and comfort can be affectively achieved even within budget and resource constraints. Hence such models should be promoted and adopted on a larger scale.

Technological Aspects in Shelter: This section will look at the materials used and respondents' attitudes towards them.

Technological Hypotheses *Despite efficient alternative building material options present choices adopted are not cost, resource and energy efficient.*

Questionnaire survey data:

In response to the question on what they though was the most popular and conventional material all the respondents responses were cement and brick. This question was open

ended as well in order to receive not only user inputs but also to gauge their awareness to building materials. The responses suggest that the respondents are mainly aware of conventional brick and concrete. The results are given in the table 4.43 given below.

What do you think is the most popular and convenient material?

Cement	Brick
6	6

Table 4.43

In response to the question on whether they felt that new materials were replacing old ones, all respondents said yes. The results are given in the table 4.44 below.

Do you think that modern materials are replacing age-old materials?

Yes	No
6	0

Table 4.44

In response to the question on how they felt about modern materials replacing age-old materials all the respondents used comments translated by the translator as good. The results are given in the table 4.45 given below.

What do you think are the advantaged and disadvantages of new materials replacing traditional materials?

Good	Bad
6	0

Table 4.45

However in response to the question on how they felt about using materials like mud, all respondents expressed preference to conventional materials like brick. Their responses have been categorised under negative remarks. The results are given in table 4.46 given below.

How do you feel about using local materials like mud?

Positive Remarks	Negative Remarks
0	6

Table 4.46

Interview survey data:

In response to their satisfaction with the building materials used in their house all respondents said yes. The results are given in the table 4.47 given below.

Are you satisfied with the building materials used?

Yes	No
6	0

Table 4.47

Site survey observation and secondary data:

The main material used is locally available brick. The brickwork used is in these developments use English bond, some developments have also used rattrap bond, which has good insulating properties, is strong and saves 25% of bricks and mortars (Costford Publication). According to the Costford member in order to build houses more cost-effectively, the houses have been constructed using local brick. Brickwork is kept exposed thus saving the cost of plaster as well resulting in 10% reductions in the total cost. Also long term savings can be made due to low maintenance of the brickwork. The different material, which have been used in these developments are as follows:

For Doors: Wood
For Windows: Grills
For Walls: Exposed Brick
For Roof: RCC and Fillers Slab
For Floor: Cement Flooring

Innovative technology of fillers slab shown in figure 3.12 in the following page, has been used in the roofs along with cement, these tiles reduce the quantity of cement used in roofs. (R.C.C filler slab 1:2:4 mix. For fillers lightweight bricks or Mangalore or country tiles are used and shown in the figure 4.13 and figure 4.14 in the following pages. According to the Costford member interview respondent, this can reduce the cost of RCC slab by 30-35% and also the amount of cement used is reduced as it is only used as filling in between the bricks or the tiles). In this development and other similar LIG development Costford has succeeded in implementing the cost-effective alternate technologies within the state of Kerela however a larger scale dissemination of this technology has not been as successful in other states.

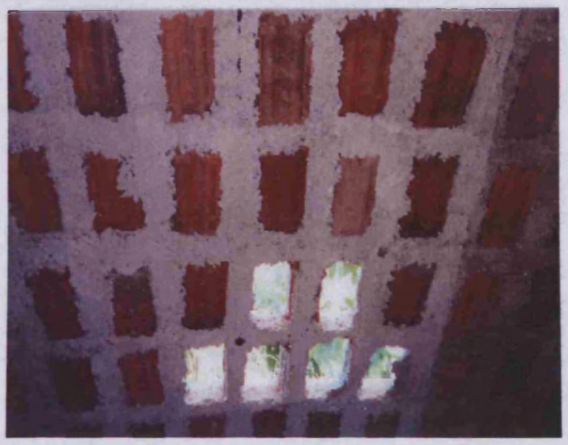


Figure 4.13

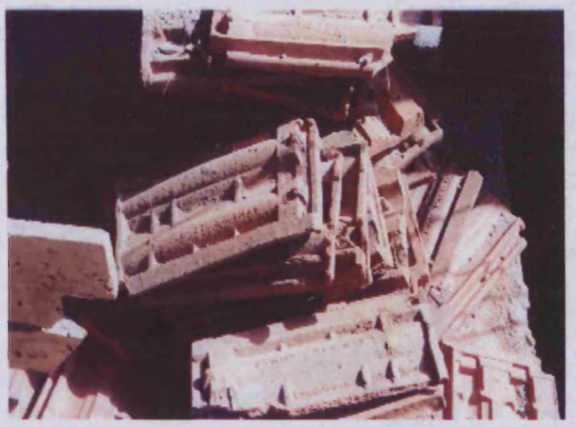


Figure 4.14

Fillers slab can be used in roofs as well as staircase blocks as shown in the figure 4.15 given below.

Figure 4.15

This study suggests that in this housing cluster a higher number of the respondents are more aware of conventional materials and also prefer the use of conventional material to alternative materials in their houses. Even though most conventional materials are energy and cost intensive the respondents preferred them to more effective appropriate alternative technologies. In response to the question on there awareness of alternative materials used all the respondents response was no.

This study demonstrates that cost effectiveness can be achieved in ways, which not only minimise use of materials and resources through permutations and combinations but also maintain quality. However the bricks used are not produced in efficient production units therefore this area needs to be addressed which would lead to long-term saving.

4.6.5 Summary:

Given below are Advantages and Disadvantages in this Development:

Advantages:

- User participation and their needs have been integrated into the planning of these houses.
- Use of local human resource skilled and unskilled labour has been adopted which also promotes local economy.
- Materials used are innovative cost effective and local.

Disadvantages:

- Main material used is brick, which are still produced in inefficient traditional style brick kiln burners, which consume more energy.
- Alternative cost effective options have been successfully used in Kerela however there is still need for decimation of cost-effective techniques on a larger countrywide scale through inter state technology transfer.

The literature review of housing in urban centres in India indicates a shortage of basic housing and infrastructure services for the low income and the economically weaker sections. This is mainly a result resources/funds/land scarcity and high cost of conventional construction materials. As a result, a large section of the urban community end up in squatter settlements in unhealthy environments and compromises on quality of life. However this case study demonstrates that this problem can be effectively addressed on a small scale by bringing together various components of housing like alterative technology, passive planning, use of local skills and resources and integrating user needs by adopting user participation. Also showing that the adoption of new approaches like the use of

scientifically researched and developed cost effective building technologies can significantly reduce construction costs. Use of locally produced materials reduces long distance transport costs reducing the embodied energy as well. Also the use of proper planning, passive systems and suitable materials has resulted the participating respondents rating indoor comfort as fair without the dependence on mechanical systems reducing operating costs as well. Another important aspect of passive planning is that most low-income households cannot afford mechanical systems and therefore maximisation of passive planning is essential for comfort. The only drawback that non-governmental institutes face is that these programs are being implemented only on smaller state level scale. Therefore more government support and work along with local NGO's to address shelter at grassroots level is required. This study indicates that these units are sustainable as they sustain local economy using local resources, are cost-effective, affordable and encourage user participation thus involving people in the planning process. However one area, which needs attention, is the production unit of popular conventional materials like brick are still old units and highly inefficient and require upgrading.

4.7 Stage A Case study III: New Mumbai Housing Developments

4.7.1 Introduction:

Stage A Case Study III is a low income group (LIG) and lower middle income group (MIG) housing units in New Mumbai implemented by City and Industrial Development Corporation Limited (CIDCO). This study was conducted in the month of October 2001. During the site visits a set of 100 questionnaires (refer to Appendix 1) were randomly distributed between LIG site and services plots and lower MIG flat dwellers in Vashi node (node explained in detail in background section). Data collected from 3 interviews using the interview set questions have also been used for this study (refer to Appendix 3). Also data from two structured interviews (refer to Appendix 3) conducted of 2 CIDCO engineers involved in construction work have also been used for the purpose of this study. In addition published data by CIDCO collected during site visits to CIDCO office block has been used as secondary data to support this study.

Design and Execution: Mostly CIDCO (Public Sector), site and services plots though allocated by CIDCO, units built by individuals

Background on development of New Mumbai:

Mumbai is located on a long and narrow breakwater, which protects the harbour from the open sea. The population of Greater Bombay rose from 2.966 millions in 1951 to 4.152 millions in 1961 and 5.970 millions in 1971, registering 40.0and 43.80% growths during the first and second decades respectively (Official Report, CIDCO). Mumbai has been the financial capital of India since independence and contributes to almost half the total revenue collected by the government of India. Today Mumbai is a gigantic metropolis of over eleven million people with additional three million in the immediate regions. Mumbai has grown over the last few decades in terms of economic growth, population growth as well as urban sprawl. However as real estate prices kept soaring, physical conditions have deteriorated alarmingly. Despite that the cost of real estate is almost twice as much as any other Indian city today. Limitations are the shape of the city, which can only extend northwards and is shown in figure 4.16 below. But Mumbai's central business district is positioned at the southernmost tip, resulting in a busy traffic movement heading southwards in the morning and northwards in the evenings and is shown in figure 4.17 in the following page. Thus in order to avoid this long distance commuting, people prefer living near their workplace leading to escalating real estate prices in the city centre at the southern end. Since, the upper and middle-income groups have already occupied much of this area, the poor are forced to live elsewhere (Charles Correa, 1999).

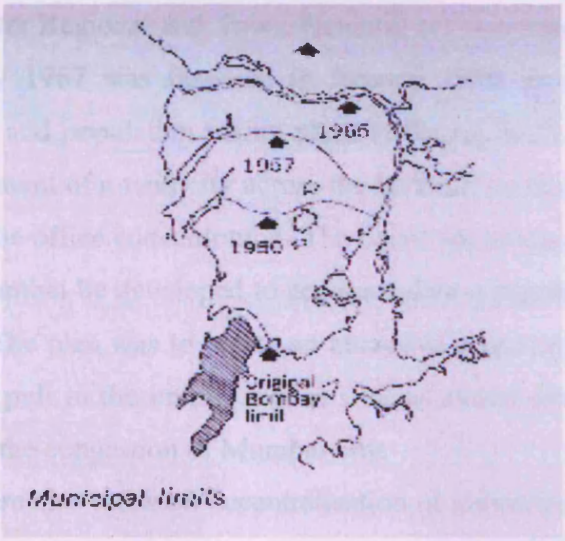


Figure 4.16

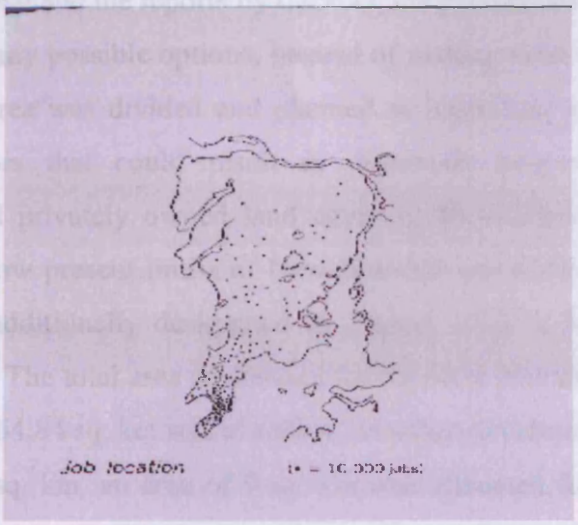


Figure 4.17

The rapid rate of growth of urban population due to employment generation through industrial and commercial growth has also resulted in a fast deterioration in the quality of life for the majority of people living in the city. Housing facilities in terms of quality, quantity and affordable prices have led to around 40% of the population to live in squatter settlements (Tapati Mukhopadhyay, 2001).

During the 1960's, the authorities began to realize that the city of Mumbai would soon be unable to meet the demand of housing and other services due to its fast growing population. Also developmental inputs could not keep pace with the fast growing industry, trade and commerce. Maharashtra Regional and Town Planning act was passed in 1966 and brought into force in January 1967 was finalised in January 1970 in order address the over-concentration of jobs and population taking place at the southern tip of Mumbai. The act proposed the development of a twin city across the harbour, on the mainland to the east, as a counter magnet to the office concentration. The board recommended that the new metro-centre called New Mumbai be developed to accommodate a population of 21 lacks (1 lack is equal to 100000). The plan was to create an attractive urban area and relocating offices across the harbour to pull in the immigrants as well as attract some of Mumbai's present population and divert the congestion of Mumbai city.

Recommendations were also made on decentralisation of industries with severe restrictions on further industrial growth in Mumbai region and development of the mainland area as a multi-nucleated settlement called nodes, each settlement smaller in size than 2.5 lacks (1 lakh=100,000) of people developed along mass transit axes. According to the interview

with the CIDCO official and the reports by CIDCO, the planners of New Mumbai proposed a plan that kept as many possible options, instead of making detailed layouts for the entire plan and the entire area was divided and planned as individual nodes. This was done in order to avoid errors that could result in disastrous long-term consequences The Government acquired privately owned land covering 86 villages and measuring 15,954 hectares within the now present limits of New Mumbai and further 9 villages, measuring 2,870 hectares was additionally designated in August 1973 to be included in the New Mumbai project area. The total area designated for the New Mumbai project was 343.7 sq. km, out of this only 264.84 sq. km was available for urban development. The regional parks accounted for 72.25 sq. km, an area of 9 sq. km was allocated for sewage farming to be built. The farm with a capacity forl million gallons of sewage per day and serving approximately 50 hectares of farm and products were to find a ready market in the urban area. An area of 9 sq. km was provided for fisheries, the area remaining for urban development was 174.59 sq. km. In the year 1981 29% of the mushy or stony wasteland 88 villages were reclaimed. In 1991, New Mumbai transformed from rural wasteland and rural villages to urban residential, industrial and commercial complex through land reclamation (CIDCO Official Report). But the reclamation of such a large area of land was unsustainable as it incurred huge expenditures, created serious environmental problems. As a result of these developments, agriculture the main occupation in most villages went down tremendously with a major shift to non-agricultural activities, which deprived some of the villagers of their only source of income. These developments have taken away the opportunities of existing old towns in the northern border of Mumbai for future development and the resources the local villagers depended on. The initial reclamation process was based on traditional reclamation method involving massive quarrying activities to raise the marshy land to at least 4 metes of height. Although the reclamation has added a new strip of land along the coast it also changed the coastal configuration simultaneously, affecting the coastal marine ecology and the 27km square of saltpan that was the primary resource of the coastal area. Reclamation and quarrying that continued simultaneously also affected the slope of the land to such an extent that several rivers became dry and an artificial situation of water flooding, more so during monsoons with high intensity of rainfall was created (Tapati Mukhopadhyay, 2001). Due to the failure of the traditional method of reclamation the Dutch reclamation method was adopted with holding pond

system. But this system proved to be expensive as well as these holding ponds were not long lasting due to the high rainfall rate and heavy runoff.

In each node location of jobs and residences were planned in close proximity in order to save commuting time and avoid traffic congestions. Mass rapid transit systems were planned to be located in such a way that walking distance to the transit system did not exceed one kilometre for most users and bus stops were to be conveniently located. The other objective of creating New Mumbai was to support statewide location policies, which would eventually lead to a well-organized and reasonable distribution of industries over the state, to create a balanced development of urban centres and to provide social services. The aim was to raise living standards and reduce disparities in the facilities available and also provide training and facilities to the existing local population in the project area enabling them to adapt to new settings and to participate fully and actively in the economic and social life in the new city.

Planners of New Mumbai aimed to provide every family living in New Mumbai a dwelling unit of their own, however small, if not permanent then made of temporary materials by provision of sufficient security of tenure of the plot of land in order to encourage the families dwelling in temporary dwellings to a more permanent type of construction. (Official Report, CIDCO). Figures 4.18 and 4.19 given below and the following page shows houses built and upgraded privately in a lower middle-income and low-income settlement.

Figure 4.18

Figure 4.19

Background on CIDCO:

City and Industrial Development Corporation Limited (CIDCO) were created in the year 1970. In March 1971, CIDCO was designated the new town development authority for the New Mumbai project. In October 1971, CIDCO undertook to prepare and publish a development plan as required by the Maharashtra Regional and Town Planning Act (1966) (Official Report, CIDCO).

4.7.2 Location: New Mumbai is located across the harbour; on the mainland to the east of part of Mumbai (which was earlier known as Bombay) and is shown in figure 4.20 in the following page. The case study is located in the first node developed called Vashi. According to official reports, New Mumbai was planned keeping in mind the convenience of living and travelling to work, efficient use of resources and avoiding architectural grandeur in order to develop a sustainable city where the common man would live. In order to provide equal services to all, shelter provision in each node was to be made available for different income groups creating a healthier urban environment with uniform standard of urban infrastructure services in all neighbourhoods. This plan was adopted so that no particular class of residents would be better served than the other. However according to the CIDCO official some nodes are better preferred and chosen by the more affordable groups over others because of reasons such as location, better accommodation, scenic beauty and other advantages and this mix could be controlled only to a certain extent. Vashi is one such node.

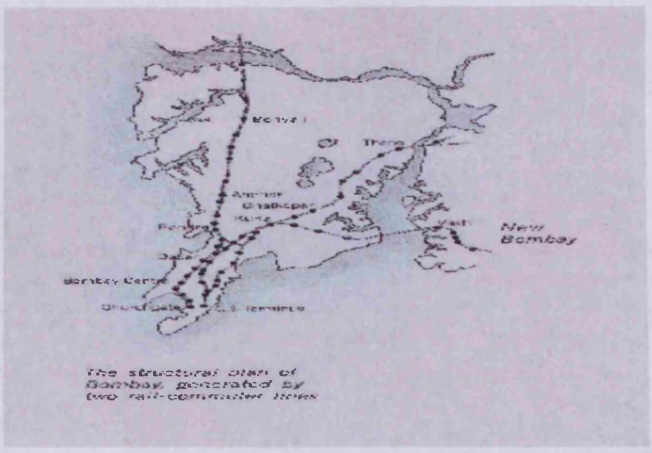


Figure 4.20

4.7.3 Procedure: New Mumbai has several nodes but for the purpose of this study LIG and lower MIG housing units in one node called Vashi were chosen. Vashi is the first node to be developed which will give this study more opportunity to study a more established yet recent shelter settlements. Regular site visit surveys were conducted to lower middle-income group housing and low-income group housing. During the site visits a set of 100 questionnaires was randomly distributed between the LIG and lower MIG households, which were collected after two weeks, and a response of 21 numbers was received, 5 were from MIG households living in public sector flats and 16 from LIG respondents living in of site and services units. Site visits to CIDCO office block was also conducted during which 2 CIDCO were interviewed. These interviews provide some insight into the planning system of CIDCO. Official data published by CIDCO was also collected during these visits and has been used for the purpose of this study. The data collected is analysed and the results presented in tables. Photographs taken during the site surveys have also been used to support this study.

4.7.4 Analysis: In this section of the study the social, economic, environmental, political and technological aspects of lower MIG and LIG housing will be investigated in order to access present shelter conditions in a relatively new city based. Whether successes and lessons learnt from older developments of Mumbai city have been applied in the planning of New Mumbai. Questionnaire surveys and structured interviews during site visit surveys are methods used for data collection.

Detail of a site and services house: each site and services plot is approximately 30 sq metres with connection to basic amenities of water, electricity and sanitary facilities. These serviced plots are catered for the LIG section of the community on which they can build basic units and improve it over a period of time. Most of the units comprised of an all-purpose room, one to two bedrooms, a kitchen, a bath, WC, veranda and a service yard. From site observations it is evident that main materials used was brick for the walls and Mangalore tiles for the roof and shown in the figure 4.21 given below.

Figure 4.21

Detail of lower MIG flat block: these were mainly g+3 RCC structures with units of around 26.11 and 30.16 sq metres each and the picture of a structure can be seen in the figure 4.22 given below.

Figure 4.22

Social Aspects in Shelter: In this section the investigations on satisfaction levels of respondents will be gauged on areas concerning their shelter units, services provided and whether their needs have been considered in the planning of their house. In addition their inputs on location preferences, demand for a particular house type, awareness levels will

contribute to a better understanding of the opinions, lifestyles, needs and preferences of this category.

Social Hypotheses *Urban housing conditions do not satisfy the general housing needs of the dweller.*

Questionnaire survey data:

Major issues affecting shelter: in response to the question on what according to them were the major issues that affect shelter today from the options given, most respondents said economical with comments on the high cost of shelter in cities, a few said technological as well. The results are shown in table 4.48 given below.

What do you think are the major issues affecting shelter today?

Social	Economical	Environmental	Technological
0	21	0	5

Table 4.48

Satisfaction levels of the 15 questionnaire respondents

General Satisfaction: In response to the question of general satisfaction from their shelter units, most respondents living in the site and services houses responded yes. However the LIG respondents living in public flats were dissatisfied. These responses suggest that the respondents living in houses self built and having more control are more satisfied than those living in units with no or very little control. The results are given in the table 4.49 given below.

Are you satisfied in general with your home?

	Yes	No
Site and services respondents	16	0
Public flats units respondents	0	5

Table 4.49

Service provision: In response to the question on satisfaction with the provision of services, respondents expressed dissatisfaction and said mainly with the water supply services. The results are shown in the table 4.50 given below.

Are you satisfied with the services networks provided?

	Yes	Not all services
Site and services respondents	0	16
Public flat units respondents	0	5

Table 4.50

Incorporation of their needs and preferences in design and planning of their home

In the area of user participation in planning and design of shelter developments 5 lower MIG housing respondents felt that their needs and preferences were not taken into consideration during the planning or the execution stages. Their units are planned and constructed by CIDCO. However the 16 site and services respondents said yes with comments like 'its self built', 'have more control over their units in terms on cost and choice of materials', 'they built their own units with the help of private builders and contractors'. The results are shown in the table 4.51 given below.

Do you think people's needs are taken into consideration in planning and design of their home?

	Yes	No
Site and services respondents	16	0
Public flats respondents	0	5

Table 4.51

User Preferences:

Housing type: In response to the question on demand for a particular type of housing between low or high-rise, all respondents choose for low rise. The results are given in the table 4.52 in the following page.

Do you think there is a demand for a particular type of housing these days?

	High Rise	Low Rise
Site and services respondents	0	16
Public flats respondents	0	5

Table 4.52

Preference in location: In response to the question on choice of location, all 21 respondents said they preferred living in the suburbs. Therefore the respondents preferred Navi Mumbai to Greater Mumbai for reason such as; greener, pollution free, close to Greater Mumbai, close to workplace, enjoy nature, independent houses, offers suburban lifestyle in urban setting and with comments on the costs of shelter being more affordable in the suburban areas. The results are given in the table 4.53 given below.

Would you prefer to live in the city or the suburb?

	City	Suburb
Site and services respondents	0	16
Public flats respondents	0	5

Table 4.53

Although the respondents felt that pollution was lesser in New Mumbai, from observation and literature collected, all areas of New Mumbai are not pollution free, some areas suffer from industrial pollution while old cities like Greater Mumbai and New Delhi suffer from vehicular pollution.

User Level of Awareness

Passive systems: In response to the questions on awareness to use of passive systems in achieving indoor comfort, the residents were mostly aware of good ventilation for indoor cooling, shading devices like overhangs over windows and use of natural lighting as shown in table 4.54 in the following page.

Do you have any idea on how to improve solar gains, shading, cooling, ventilation and natural lighting?

	Windows for natural lighting, ventilation	Shading
Site and services respondents	16	16
Public flats respondents	5	5

Table 4.54

The responses received for this question indicate most people are well aware of the efficient use of windows and shading devices.

Sustainability: In response to the question of their understanding of sustainability the respondents had no comments due to difficulty in translating the meaning in the local language as was the case in case study II. The results are shown in table 4.55 given below.

What do you understand by sustainability?

	No comments
Site and services respondents	16
Public flats respondents	5

Table 4.55

Structured Interview Survey Data: This is additional data collected by the asking the interview questions while conducting the questionnaire survey.

Participation: In response to the question on participation, all the site and services respondents said yes since they all built their houses privately. While the public flat respondents said no, as their flats were planned and constructed entirely by the public sector. The results are shown in table 4.56 given below.

Have you participated in either the planning or construction of your house?

	Yes	No
Site and services respondents	16	0
Public flats respondents	0	5

Table 4.56

According to the interview data from one of the CIDCO representative, in order to have a good understanding of the physical, economic and social aspects of the proposed development and also to create a database for further future work; a number of studies were launched. The studies also included a survey sample of households in Greater Mumbai in order to bring out the demographic characteristics, attitudes to housing, preferences in terms of transport and trends in migration of the expected population. According to the CIDCO official these survey reports have been consulted for the development plan of Navi Mumbai.

Recycling: In response to the question on waste recycling all respondents said that they exchanged household waste like newspapers and bottles to rag collectors for cash or kind whenever they came by. The results are shown is table 4.57 given below.

Do you recycle waste?

	Yes	No
Site and services respondents	16	0
Public flats respondents	5	0

Table 4.57

Complaints: In response to the question on other complaints, comments from the site and services respondents were mainly high cost of services, NOC (no objection certificate) fees very high, and metre readings not accurate. Among public flat resident respondents, there were complaints on the deteriorating quality of their structures as well.

Site Observation Data:

The site and services houses are mainly single to double storey detached or semi detached houses built in serviced plots. The houses are privately built mostly in stages depending on the growing needs of a family and the economic conditions. Some of the houses in this cluster can be seen in the figure 4.23 given in the following page.

Figure 4.23

The public LIG flats are ground plus two structures and compromise of single bedroom flats. These flats are shown in the figure 4.24 given below.

Figure 4.24

Site observations show the deteriorating quality of the public flats. While the quality of these houses are being compromised, data given by one of the CIDCO official indicates that a lot of work and funds are put into beautifying crossroads and highways in order to attract NRI investments.

The poor condition of the lower units can be seen in the figures 4.24 and 4.25 in the following page.

Figure 4.25

In the case of the site and services respondents, the units were built on a self-help system based on their need and requirements. Such as keeping provision for incremental growth depending on the economic conditions and growing needs of the household. These respondents expressed satisfaction with their units. Whereas the public housing which were planned and executed by the public bodies with no user input or participation the residents were dissatisfied due to lack of space and privacy causing discomfort. The quality of these developments was also considered unsatisfactory due to dampness and other structural weakness problems. This study indicates that people with more control of their units seemed to be more satisfied.

Economic Aspects in Shelter: In this section the investigations will be carried out on concerning cost and affordability of shelter and the impact of budget on shelter quality by gauging the respondents.

Economic Hypotheses *Basic housing in urban areas remains inaccessible to the masses due to high shelter costs and budget constraints of the households and public sectors shelter providers.*

Questionnaire and interview survey data:

Impact of budget: In response to the questionnaire question on whether budget effected quality, planning and choice of materials used most of the respondents responded yes. The results are given in the table 4.58 given in the following page. Most respondents commented that cheaper materials meant a compromise on the quality and strength of the

structure. However according one respondent "it's not necessary that budget affects the cost". He commented that the same quality can be achieved though effective saving by employing a labour contract and use quality materials rather than employing a builder who gives high quotations but cheap and poor quality materials to save money resulting in structural problems like leakage. The respondent said that he saved around Rupees 1 lakh to 1.5 lakhs (£1250-£1750 approximately) in the construction cost by using labour contract.

Do you think budget affects the quality, planning and choice of materials?

	Yes	No
Site and services respondents	15	1
Public flats respondents	5	0

Table 4.58

External Aid: In response to the interview question on whether they felt that the investment on their house would be higher or lower than the cost of household energy used in a period of ten year, all the interview respondents felt it would be higher. Most respondents said they spent on an average of 5 to 6 lakh Rupees to build around 4 room units.

In response to the structured interview question on whether shelter was affordable without external help all respondents said no. 10 of the site and services respondents also felt present land and building materials prices were and therefore could only build one room at a time. Two of the site and services respondents also mentioned about the NOC fees (No Objection Certificate) that needed to be paid to CIDCO to construct any additional room, was about Rupees 64,000 (£1=80 Rupees approx). This amount according to respondents was very high for a low-income family to afford. Loans, plus office loans, plus money borrowed from relatives have been used to invest to their units.

However interview respondents felt that shelter units were more affordable in New Mumbai as compared to the costs in Greater Mumbai. According to one respondent he could afford a decent unit for around 5 lakhs, which would be impossible in Greater Mumbai. One respondent felt it was a good deal since Greater Mumbai was close around 40 Km away and easily accessible by train. However five respondents felt that the costs were still not very affordable for LIG households and could be lesser if the NOC fees were to be reduced as

every time they built additional units they had to pay a high fee making the expenditures higher. Some respondents also mentioned that they bought their plots from another person.

Secondary data collected during the site visit to the CIDCO office building:

Despite provision like site and services plots catered for LIG households, at present rates shelter in urban areas is still not affordable to the economically weaker section of the community. According to a Maharashtra government report- income of an individual or two individuals between the LIG and lower MIG is around Rupees 4,500 to 7,500 per month (£ 56 approximately) and an annual income of Rupees 54,000 (£675 approximately) (Official Report, CIDCO). According to another survey conducted by CIDCO on greater Mumbai households around 20% of the population are households that earn less than Rupees 200 per month (approx £2.50) with a capacity to pay for a rented accommodation of Rupees 1200 (approx £ 15). Around 16% earn Rupees 201-300 with a capacity for rented accommodation of only Rupees 2580 annually (£32), 51% earn between 301-600 Rupees with a capacity for rented accommodation between Rupees 4140-7800 (approx £51-97.5), 21% between 601-1500 with a capacity to pay between Rupees 10800- 30,000 (approx £ 135-137) and only 2% earn more than 1501 Rupees with a capacity to pay for rented accommodation of more than Rupees 37800 (£472.5). In Vashi development developed land costs approximately Rupees 40 (£0.50) per square metre, monthly charge for various services costs Rupees .60 per sq metre of land and building construction costs vary from Rupees 450 to Rupees 500 (£5.6-6.2) (New Mumbai Draft Plan, 1973). For households earning less than Rupees 200 per month, present shelter costs would be unaffordable.

Also government policy in publicly financed housing, has been to construct nothing smaller than a 21 sq metre tenement per family. But large percentage of households cannot afford even a minimum 21 sq metre sized tenement and therefore shelter has to be highly subsidised in order to be accessible to the poorest of the community. In the case of Greater Mumbai the system of heavy subsidies has not been viable, due to inadequate resources that sustain mass construction programs with heavy subsidies. This has resulted in a widening gap between shelter provision and the population resulting in illegal tenements with no access to sanitary or other facilities. In addition most public houses are given on a draw basis therefore most households end up either waiting for their turn or resorting to other options like private developments far away from the city fringes. Hence in the development plan of New Mumbai, the system of subsidies on shelter costs among the low-income and

surcharge among the higher income groups to make up for the subsidies has been adopted (New Mumbai Draft Plan, 1973). Shelter can only be made more affordable through financial aid, housing loans and subsidies along with the use of cost-effective measures and if land costs remain within affordable limits.

According to official data collected New Mumbai was to be developed as a self –financing project and for this purpose it has secured finance by way of loans, which were to be eventually repaid. These loans were to be used to finance development of infrastructure and other amenities needed in the area and once a house were constructed, houses would be sold and plots leased on payment of a premium to the new city residents to recover the funds invested. CIDCO aimed to achieve all these by the imaginative use of resources, both of funds and manpower. However along with the reclamation expenditures, the construction activity on the reclaimed land, under-ground construction for rainwater drainage and sewerage has resulted in higher expenditures for CIDCO. Most of the urban nodes are located on the reclaimed coastal land thus higher expenditures as compared to expenditures if New Mumbai was developed on normal land and not reclaimed land

This study supports the hypotheses. In this study CIDCO has attempted to make shelter more affordable to the low-income group by introducing serviced plot to build on and the options of flats and by giving shelter subsidies to the lower income group. However this study shows that in order to cut down construction costs, the quality of the materials used has been compromised resulting is poor quality. Although the cost of land and therefore shelter is much lesser in New Mumbai as compared to the costs in Greater Mumbai basic shelter is still beyond the reach of the poorest section of the community who still end up in squatters. Studies conducted by CIDCO on Greater Mumbai households suggest that a large percent of the population earn less than Rupees 200 a month making basic shelter beyond their reach. Cidco has also made several attempts on the use of alternative technologies, which have mostly failed incurring expenditures rather than cost savings. In this study although the cost of providing affordable shelter has been addressed by adopting site and services options and giving subsidised plots, alternative option of cost-effective technologies and materials have not been promoted and adopted. Recycling and re-use of building materials is also an important aspect of cost-effectiveness, which is absent in construction of these units.

Environmental Aspects in Shelter: This section will look at respondent's general comfort status looking at variables such as space and density, climatic suitability of the units and energy use. Questionnaire and interview surveys will be used among the respondents in addition to site survey observations and written data collected during the site visit surveys. In addition respondent's inputs will contribute to a better understanding of the comfort needs of this category.

Environmental Hypotheses *General comfort conditions are unsatisfactory in urban housing.*

Questionnaire survey data:

General Comfort: In response to the question on what according to them would affect general comfort all respondents said space and a large number also said adequate breeze through windows and cross ventilation improves shelter comfort. The results are shown in the table 4.59 given below.

What do you think affects general comfort?

	Adequate Space	Adequate Ventilation
Site and services respondents	16	12
Public flats respondents	5	5

Table 4.59

Few families of the 21 respondents expressed the need for more space with comments that the present dwelling units were not adequate for the four to five member families as a result often experienced discomfort.

Energy use and comfort: In response to the question on energy use and energy conservation in shelter, all the 21 respondents agreed that energy conservation should be an important aspect of shelter design. The results are shown in table 4.60 given in the following page.

Do you think energy conservation is an important consideration in design?

	Yes	No
Site and services respondents	16	0
Public flats respondents	5	0

Table 4.60

In response to the question on issues concerning energy and housing, most respondents complained about the high cost of electricity. Most of the respondents also commented on the shortage in power supply. The results are shown in the table 4.61 given below.

What are the issues concerning energy and housing today?

	Power shortage/power cuts	Electricity Cost
Site and services respondents	7	16
Public flats respondents	5	5

Table 4.61

In response to the question on whether the residents felt that the houses today were built considering the climatic condition, the site and services respondents response was yes because the units were built as per their liking and needs. However the public flats respondents' responses were no and all commented on the discomfort due to high humidity and used words like 'stuffy' especially during monsoons. Three of the respondents commented on inadequate windows expressing the need for larger windows for better ventilation. The results are shown in the table 4.62 given below.

Do you think your home is suitable for the type of climate it is constructed for?

	Yes	No
Site and services respondents	16	0
Public flats respondents	0	5

Table 4.62

Site survey observations and secondary data collected during the survey:

Description of the site

Mumbai has a humid climate and literature review and site observations made of existing traditional houses show that in order to achieve maximum comfort houses take advantage of cross ventilation with ample windows, balconies and verandas all around the house.

In most traditional houses sloping roofs as shown figure 4.26 and figure 4.27 given below, have been used. Sloping roof is used in order to quickly shed heavy rain, it also protects the walls from getting damp and provides shade at the same time protecting the indoors from the heat. However most of the present houses as seen in case study site visit surveys have flat roof and according to respondents inputs use of cross ventilation has not been maximised.

Figure 4.26

Figure 4.27

Density, space and comfort:

Based on site observations and interview respondents data it is evident that most families here are large with 4-6 family members and thus most of LIG and lower MIG developments here may be categorised as high-density units compared to the space available. Most units are around is 20 to 30 sq metres with floor to ceiling height of 3

metres, thus in a family of 5 persons each persons gets 4 to 6 metres. According to literature review data densities of about 8-10 metres square per person are generally regarded as being satisfactory. Most of the respondents made use of limited space available by having sleeping, working and eating quarters in the same space. In the case of the site and services plots there was scope for extension but in the case of the public flats the areas were fixed and no scope for future extensions. In response to the question on what mechanical systems they used to improve indoor conditions, all respondents said they depended on fans and four respondents said they used air-conditioners occasionally.

Additional information

During the site visits one development was found broken down and abandoned, further investigation and asking people around showed that these houses were abandoned about ten years ago, as they started falling apart over the years. Since construction work in New Mumbai started during late seventies, these houses must be not more than twenty years old when they stated crumbling and had to be abandoned. Interviews with the CIDCO officials suggest that the main cause of this was the use of sea sand in cement mixture used in the construction of these buildings. The sea sand used contained high percentages of salt (more than 30%), which is corrosive and results in seepage of the walls. According to the officials in the earliest constructions of New Mumbai, sea sand was used for construction, as it was cheaper than river sand and more readily available. A picture taken of the building is shown in the figure 4.28 given below.

Figure 4.28

From personal observations and a few general conversations with residents during the initial site surveys conducted evidence of a pungent smell in the air was detected. Further investigation suggested that it was due to emissions from the industries located close by in this area. Written data suggest that New Mumbai is located in one of the largest industry

zone in India and these industries emit high levels of toxic gas and carcinogenic chemicals along with extreme air pollution increasing the incidence of chronic respiratory problems, despite the opposition to the proposed site made by the Central Public Health Engineering Research Institute based on their study in the year 1974. The nightly burning of garbage of at the 100-hectare municipal garbage dump located in the north of locality Chembur and Vashi is also affecting quality of the air. The Environmental Health Rights Organisation of India claims that the level of particulate matter around the dump is about 2000 micro grams per cubic metre.

According to a study by Dr Tapati Mukhopadhyay approved by the Indian Council for Social Science Research, New Mumbai has been built up where ground water is not potable and the availability of surface water is insufficient. Hence surface water has become scarcer due to the changes in the drainage water pattern. Water is being supplied through two sources, which are the Barvi dam and the Patalganga River. The other sources are not very close to the urban centre of Navi Mumbai indicating that the urban space has been developed without considering proper water harvesting. New Mumbai development has ignored the coastal regulation zone policy adopted by the Government and has not only lead to higher expenditures it has lead to social and environmental problems. The two activities of quarrying and reclamation carried out at the same time has disturbed the coastal configuration which has affected the marine ecology, 27 km square long salt pan and changed the natural surface leaving no scope for surface water harvesting. Also the sewage system in the villages was not integrated with the urban system, it was expected that these villages would survive on septic tanks (Tapati Mukhopadhyay, 2001).

The respondents living in site and services units expressed satisfaction with the general comfort of their units, which had been planned and built by them based on their needs. However the respondents living in the public housing units complained of discomfort due to humidity and lack of adequate ventilation. The respondents from both the housing types were not dependent on energy intensive mechanical air-conditioners, except for the use of ceiling fan. Therefore these households do not have very energy intensive lifestyles. However in both the housing developments the materials used are mainly conventional building materials, which are resource and energy intensive. Therefore the area, which needs to be focussed on, is the embodied energy content of these units. But along with it passive planning should be also integrated into shelter in order to improve indoor comfort

without the need for dependence on the unaffordable mechanical systems and promote energy efficiency.

Political Aspects of Shelter: This section will gauge user awareness of shelter policies and schemes in order to access the level of exposure to shelter schemes and the interaction between the respondents and government shelter body representatives.

Political Hypotheses *Housing policies and programs are based on public body understanding of user needs and not on real user inputs.*

Questionnaire and structured interview survey data:

User awareness to political targets and schemes

According to the questionnaire survey responses most respondents were not aware of any political targets concerning shelter. This indicates poor awareness level among the respondents to schemes and issues that concern them. This suggests that there is no public contribution or participation involved concerning shelter at the macro or micro level. The results are shown in the table 4.63 given below.

Are you aware of any political targets for housing?

	Yes	No
Site and services respondents	0	16
Public flats respondents	0	5

Table 4.63

From observations made during site surveys and responses of the 21 respondents, it is evident that in these developments as well more focus has been directed towards quantitative aspects but the qualitative aspects of shelter have been not been prioritised.

Among the respondents general awareness to government polices and schemes was very low indicating an absence of interaction between the user and the public body representatives concerning shelter. The public flat in this study has also been planned and executed by Cidco, based on their understanding of user needs. Government shelter schemes and polices focus on quantitative targets, which need to be achieved within a

limited budget and therefore given priority. But the priority does not confine itself to providing basic shelter only; fulfilling user needs from shelter also requires attention, which can be achieved though public participation in shelter developments and transparency of shelter polices in order to promote user awareness and public feedback.

Technological Trends in Shelter: This section will look at the materials used and respondent's attitude towards them.

Technological Hypotheses *Despite efficient alternative building material options present choices adopted are not resource and energy efficient.*

Questionnaire survey data:

User preference

The question on what users thought was popular among building materials, was open ended in order to receive not only user inputs but also to gauge their awareness to building materials. In response to this question all the respondents' responses were cement and brick. The results are shown in the table 4.64 given below.

What do you think is the most popular and convenient material?

	Cement	Brick
Site and services respondents	10	7
Public flats respondents	4	1

Table 4.64

All questionnaire respondents answered yes to the questions on whether traditional materials were being replaced by materials like brick and cement and expressed satisfactions with this change. The respondents felt than concrete and brick were more permanent, long lasting and durable as compared to materials like mud and thatch. The respondents' remarks have been categorised into good and bad. The results are shown in tables 4.65 and 4.66 in the following page.

Do you think that modern materials are replacing age-old materials?

	Yes	No
Site and services respondents	16	0
Public flats respondents	5	0

Table 4.65

What do you think are the advantages and disadvantages of this change?

	Good	Bad
Site and services respondents	16	0
Public flats respondents	5	0

Table 4.66

In response to the question on how they felt about the use of local materials like mud, all respondents said no and gave reasons like not very permanent, not long-lasting, high maintenance, unfeasible material for larger scale units. The respondents' remarks have been categorised into positive and negative remarks and the results are given in the table 4.67 given below.

How do you feel about using local materials like mud?

	Positive Remarks	Negative Remarks
Site and services respondents	0	16
Public flats respondents	0	5

Table 4.67

Interview survey data:

In response to the question on their satisfaction with the building materials used in their house all site and services respondents said yes, however the public flat respondents expressed dissatisfactions and complained of the poor quality of materials used resulting in dampness and leakage. The results are shown in the table 4.68 in the following page.

Are you satisfied with the building materials used?

	Yes	No
Site and services respondents	16	5
Public flats respondents	0	0

Table 4.68

In response to the question on there awareness of alternative materials used in their house all respondents said no and preferred conventional building materials like brick and concrete, one respondent said he went to an exhibition on new materials and collected pamphlets for use in the interiors of his house

This suggests that higher numbers of the questionnaire and interview respondents are more aware of conventional materials and also preferred the use of conventional material to alternative materials in their houses. Despite most conventional materials being energy and cost intensive the respondents in this case study preferred them to more effective appropriate alternative technologies.

Site survey observation and secondary data collected during the site visits and information gained from the interviews conducted of the 2 CIDCO official engineers:

In these houses conventional materials have been used and according to the 2 CIDCO officials interviewed most of the builders prefer to use concrete and bricks, since they are more accessible while traditional materials are not available on a larger scale. Also social factors such as stigma and unacceptability due to lack of user friendly application systems theses materials and technologies have not managed to infiltrate into the domestic market. The materials, which have been commonly used for construction in these developments, are given below:

For Doors: Wood/Timber

For Windows: Glass and Aluminium

For Walls: Brick

For Roof: RCC

For Floors: Terrazzo or Cement

For Ceiling: Plaster

Although only conventional materials have been used in the case study developments, alternative materials and technologies have been tried and tested on other housing units built in Navi Mumbai. One such technology is the load bearing composite masonry involving brickwork and RCC mullions for a building with five floors using very low quality of steel of 12kg/sqm. This was possible because of the use of modular planning and large size prefab panels where steel and cement consumption was respectively 17kg and 0.3cm/sqm. However due to initial reaction of the buyers who termed the construction as user non-friendly these constructions were suspended. According to official reports acquired, large size prefab also required meticulous planning and management. This indicates that most decisions are carried out on official decisions made by the bureaucrats and public preferences are not considered. The official reports also acknowledge that a detailed examination of consumer reaction would have aided in the evaluation of technology in proper perspective.

Around that time there was shortage of cement but despite this shortage Mullion construction technology for walls and pre-cast channel slab type of construction for floor and slabs was undertaken which required almost equal amount of cement to conventional systems. According to reports this technology also required managerial skills for coordination of pre-casting and erection activities, demanded more skilful masons and the availability of skilled masons determined the pace of construction. The contractors choose conventional technology over this technology as this technology required meticulous planning and management, other technological difficulties like difficulty in effective sealing of joints in pre-cast elements and the residents of these buildings complains of leakages. Failure of this technology lead CIDCO back to the use of conventional technology.

Another system known as 3-S system was adopted for its manageable and quality effective technology. This technology had a comparatively better pre-cast quality but had many joints. Also the steel requirement was high about 35kg/Sq.M. Other problems were strenuous construction, inefficient deployment of heavy construction machinery and the residents of such complexes were dissatisfied and complained of dampness, seepage and consequent corrosion due to improper seal in between the joints This indicates the absence

of assessments on the applicability to climatic conditions and long-term effects of this technology.

Failure of these technologies and high costs incorporated in their implementation, lead CIDCO to make efforts towards reducing future project costs by adopting self-help technologies developed by CBRI (Central Building Research Institute, India). But this step was not successful as the management of technologies proved difficult and resulted in wastage. Also users did not readily embrace self-help technology due to lack of technical know-how and therefore residents reverted back to conventional technologies. Contactors also reverted back to conventional technologies as the transportation of precast elements to site also proved difficult. But for CIDCO the search for suitable construction technologies continued and this search lead to the use of tunnel technology which is one of the latest technology being used in the new housing constructions of New Mumbai. The aim was to reduce cost over run time and improvement of quality, the figure 4.29 below and 4.30 given below and in the following page shows the tunnel technology in a new development housing construction site in New Mumbai. As these houses are in their construction stage the performance and user satisfaction of this technology is yet to be determined (Official Report, Sri P.M.Deshpande et al).

Figure 4.29

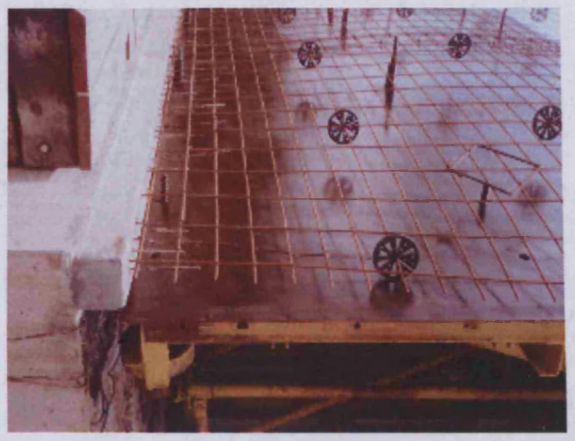


Figure 4.30

According to the reports new alternative technology materials have been experimented on in some developments but all of them were discarded eventually as they failed to work and hence reverted back to conventional materials. Many factors were given in the report for failure of new technologies adopted, which included the need for skilled labour which was limited and technologies being user non friendly indicating the absence of assessments on user needs and viability. Indicating that investigations about the use and long-term success of this technology were not undertaken before implementing these systems. Hence for technology options to work they must not only be good quality, cost and energy effective they must be acceptable to the user and be simple to execute in order to be applicable to shelter construction for the masses.

4.7.5 Summary:

Given below are Advantages and Disadvantages in this Development:

Advantages:

- New Mumbai has helped in easing the growth of population of Greater Mumbai.
- New Mumbai is a new development thus has more scope for planning and implementation of new ideas and technology.
- The houses are comparatively more affordable than houses in Greater Mumbai especially for the low-income groups.

Disadvantages:

- The public houses lack user participation.

- The quality of the public housing executed by CIDCO in this case study is of very poor quality.
- Most new technologies used in construction have failed leading to unnecessary waste of funds and resources.
- The local villagers have got displaced and lost their occupation due to the development of New Mumbai.
- Reclamation has also disrupted the marine ecology and dried the saltpan area that was the primary resource of the coastal area and a source of income for the local villagers.
- Certain nodes with residential units are located near toxic industrial emission zone.

According to official reports, New Mumbai was planned as a twin city to draw the exiting as well as the migrant population from Greater Mumbai with the offer of a better quality of life. But this aim has not been entirely achieved since the quality of life according to the low-income respondents is not very satisfactory. According to the reports the urban nodes of New Mumbai are located on reclaimed land hence incurring higher expenditures. In order to accommodate a population of 50,000 to a population of not more than 200,000 in every node, larger numbers of shelter units are needed and limited funds may have resulted in a compromise on shelter quality and structure which are evident in this case study. The reason for dissatisfaction of the public housing respondents could also be associated to the absence of user participation hence absence of their real needs from shelter. Since in comparison the site and services respondents expressed more satisfaction with their units, which were, self built.

In the area of innovative technology although efforts have been made by CIDCO in order to innovate and improve shelter conditions by adopting a number of new alternative building material technologies in some of the new developments all of these efforts have not proved to be viable. This may be due to reasons such as lack of proper surveys on user needs and pilots not carried out to test workability, long-term costs not being considered and lack of skilled labour. Resulting in poor quality developments and low rate of user satisfaction and unnecessary costs. Even in the case of water collection, collecting ponds have been used however rainwater harvesting for households have not been adopted, which would suffice additional household needs. Hence the planners should incorporate surveys on user needs and make proper assessments of all aspects of shelter development, as the first step to

shelter planning and development in order to improve their housing programme. This study suggests most shelter developments in New Mumbai are not sustainable, as they have failed to consider user needs and also the long-term cost and environmental impacts.

In addition, in the process of providing a better life for the urban population the existing village communities have been disrupted and displaced from the homes and farmland -their main source of income affecting their life. The planners of New Mumbai failed to incorporate the existing villages into the urban structure. In addition, data collected from books and official reports suggest that the existing saltpan has been disrupted due to the reclamation process, which was also a source of income for the village coastal dwellers. The saltpan has dried up, fishing has declined and most of the agricultural land has been converted into urban area development. This has resulted in a large section of this community migrating out of this area and from their homes, which means that they would have to find new land and build new houses incurring further expenditures. This suggests that planners of New Mumbai have ignored the long-term impacts of development and instead protecting, serving and supporting the rural population, their environment and their economy, it has displaced them from their homes contributing to the vicious cycle of rural-urban migration. Thus the whole objective of relocating families is completely lost since the existing village population have gradually got displaced from their homes and livelihoods in order to accommodate the incoming city and migrant population.

4.8 Summary of the three case study results: the three case study results have been summarised in order to help develop set B hypotheses.

Social Aspects: in these three case studies in the social aspects of shelter took a look at the user shelter relationship with respect to user needs from shelter and respondents general satisfaction levels. In order to help gauge satisfaction levels the questions concerning level of user awareness, preferences and lifestyle choices have been used as to rate general satisfaction.

Integration of user needs and its influence on satisfaction levels: Among the three case study respondents 86% rated shelter as good and moderate out of which 59% were felt that their needs and preferences had been incorporated and 41% felt that their needs had not been incorporated. 13% of the respondents rated shelter comfort as unsatisfactory. 88% of the respondents preferred low-rise and all the case study units happen to be low rise

structures, a larger percentage preferred to live in the suburban areas and all the case study houses are located in the city fringes and at commutable distances from the main city centre. Therefore integration of user needs and preferences may have some influence on satisfaction levels. The level of control in the options available also seems to be a very important contributor to user satisfaction among these case study respondents.

Level of user awareness and its influence on user preferences and lifestyle choices: in all the three studies, respondents were generally aware of natural ventilation and use of natural devices for shading, which have been adopted by the households. Interview responses indicate some actions adopted towards energy conservation by households like adopting more efficient lighting systems, which have been well advertised by media. Most households also are dependent on ceiling or table fans which promote air circulation and where affordable air-conditioners to improve thermal comfort. Awareness to alternative options like passive cooling systems and thermal properties of building materials etc is low. In the case of building materials commonly used conventional building materials like brick and concrete were more popular among respondents, which were associated with certain properties like durability, security and to some extent social status of households. These examples are likely indicators of how choice is determined by awareness levels, preferences and familiarity and to large extent affordability. Familiarity to products determines user preference to a certain extent as well and incorporation of user preferences and needs in shelter to an extent determine user satisfaction levels. Therefore more awareness, exposure, familiarity etc should be encouraged among households about the cost and other long-term benefits of various options. Thus in order to move forward in sustainable shelter, actions need to be adopted which target awareness levels, have social and environmental benefits and improve access to information.

Economical Aspects: In these case studies respondents responses on shelter cost & income levels, budget, materials and technologies adopted, external aid and location, have been used as indicators of factors affecting access to shelter.

In all case studies, the respondents felt that the cost of shelter was an important aspect affecting shelter access. The data gathered from this study indicate that the factors affecting shelter access was higher shelter costs as compared to the earning capacity of households. The cost of shelter is affected mainly by the cost of planning and construction, technology and materials used and the costs of land in urban areas.

A large percentage of the case study respondents felt that budget affected the quality of materials used and shelter, one could acquire. For instance, in the case of materials used most households with more budget showed preference and adopted conventional building materials in shelter. However poorer sections cannot afford most conventional materials in the market and therefore settle for scavenged materials. However this is not always the case, as in case study II, it can be seen that same if not better quality building materials and shelter can be acquired with less budget.

All case study respondents felt that aid was essential in making shelter more affordable since their earnings alone could not support shelter cost. Most middle and low-income households take bank loans and loans from family.

Shelter affordability is also determined by location, since land is more expensive in central locations and cheaper at the fringes. All the three case studies were located around the fringes.

Environmental Aspects: In this section the questions were developed to see how house design determined energy use, whether urban households are dependent on mechanical systems for indoor comfort, what their views were on energy use and what according to them would affect comfort. Case study respondents living in self-built houses having more control over their environments seemed to be more satisfied as compared to households living in public built units. Most respondents agreed that energy conservation was important. In response to the question on issues concerning energy and housing, most respondents mentioned power failures. Case study I respondents were more dependent on air-conditioners, which may be a result of climatic conditions, discomfort and affordability. Respondents of the other two case studies belonged to low-income groups were not dependent on air-conditioners, also temperature was moderate in these two case study locations.

Most respondents (94%) attributed adequacy of space to comfort. This may be due the high population density and lack of space in urban areas of India.

Political Aspects: with respect to political aspects concerning the user and shelter relationship the level of user awareness to shelter schemes and policies was taken as indicators of shelter schemes and programs -advertising, accessibility, exposure and the respondents level of involvement concerning micro level shelter aspects. Level of public awareness to shelter programs is low among low-income respondents. Even the among the more literate middle-income group households, awareness levels were low suggesting that

level of awareness is not dependent on literacy levels and better understanding. Therefore effort needs to be put into informal education, which will promote more awareness among all sectors of the community.

Low awareness also indicates poor communication between public bodies and individuals of the community.

Technological Aspects: within this section the technology and characteristic of building materials used in the case studies have been looked at. Questions concerning user preferences and their input on alternative technologies have been used to determine properties of more popular and widely accepted materials.

Commonly used materials in all the case studies were mainly brick and cement. A larger percentage of the case study respondents have given preference to these materials and expressed their satisfaction. Therefore supporting the argument that incorporation of user preference is an indicator of user satisfaction and exposure and familiarity to some extent determine preference.

Among all respondent households' factors like familiarity, exposure to and faith in the physical properties they embody seem to play a more significant role in success of the product, despite presence of other cost effective ecologically sound options. Case study public sector housing bodies also adopt more conventional materials like brick and concrete due to user preferences. According to CIDCO officials interviewed attempts to use other materials have mostly been unsuccessful and one of the reasons being user and contractors in-acceptance to new technologies. However the argument on dependence of preference and acceptance on familiarity and exposure is not entirely baseless, then lack of exposure to new more efficient technologies might be the reason for their unsuccessful applications. Therefore, before any product is developed and launched, large-scale surveys on public opinions, preferences and large-scale publicity for the products and technologies should be adopted. For instance the case study analysis suggests that most respondents prefer brick and cement because they represent properties such as strength, durability and permanence, properties that they consider essential. Therefore new alternative materials should also have these properties and be promoted stressing on these basic properties for wider acceptance.

4.9 Hypotheses set B Development:

The set B Hypotheses developed is based on the results of the three stage A case studies and will be tested in the stage B case studies. They are as follows:

Social Hypotheses- discussions in section 3.8 suggest that in the case studies where respondents who had more control in integrating their needs and preferences in their shelter settings were also more satisfied as compared to respondents with very little or no control. Set B hypotheses given below will therefore investigate further the whether is any relationship between shelter process and user participation/contribution in the stage B case studies. The hypotheses developed is stated below:

- **There is a relationship between user participation, preference and needs inputs in house planning and user satisfaction.**

Economic Hypotheses- From discussions on the economic aspects in section 3.8 it can be assumed that despite efforts by the government and housing bodies and focus on economic development, basic shelter is not accessible to the poorest sections of the urban low-income community. Mainly due to rising shelter costs but low levels of affordability. Set B hypotheses will investigate the relationship between present shelter costs and access to shelter. The hypotheses developed is stated below:

- **There is a relationship between affordability factor, present costs of shelter and access to shelter.**

Environmental Hypotheses- This study suggests present shelter units are not satisfactory in terms of thermal comfort and are energy intensive in terms of high dependence on mechanical air-conditioning. Case study respondents who felt that their units were not climatically suitable were also more dependent on mechanical systems. However the households with less economic stability were less dependent on air-conditioners and therefore endured regular discomfort. Set B hypotheses will investigate further the relationship between thermal comfort, energy use and shelter. The hypotheses developed is stated below:

- **There is a relationship between thermal comfort, energy use and shelter.**

Political Hypotheses- This study indicates that a higher number of the respondents were unaware of shelter schemes and polices that concern them and there are certain barriers to involvement in Governance. This is indicative of an absence of public participation and

communication between local housing authorities and people. Barriers to involvement in Governance concerning shelter programs and policies need to be researched and investigated further. However since the following stage B case studies are concerned more on the micro aspects such as shelter plan, materials used etc stage B case studies not be looking into macro aspects of shelter programs and policies. However stage A case studies identify that there is a relationship between public participation in government shelter schemes and their more successful applicability.

Technological Hypotheses- This study suggests that although a number energy efficient alternative technology is available at present, they are not being delivered effectively on a larger scale. Some drawbacks identified in these case studies were lack of awareness, low popularity, accessibility, and preference to existing conventional materials among users and builders and poor marketing. Stage B case studies will further investigate the relationship between, conventional building materials, appropriate technologies and shelter. The hypotheses developed is stated below:

- **There is a relationship between conventional building materials, appropriate building material technologies and shelter.**

Chapter V

Stage B Case Studies

5.1 Introduction:

This chapter discusses the three case studies conducted of shelter developments in New Delhi during the months of June 2002- Feb 2002. Case studies conducted are of public and private housing and a squatter settlement in New Delhi and the categories based on different income groups, which are low, middle and high-income groups. In case studies I and II, questionnaire survey (refer to appendix 2) and interview surveys (refer to appendix 4) have been conducted during the site survey, while for case study III questionnaire survey was carried. Secondary data from published materials and official data collected during site visits have been used where relevant in order to support and validate case study data collected. And photographs taken during the site visits have been used in order to support this study.

Background on New Delhi:

New Delhi is the capital city of India and also one of the oldest living cities in the world. Climatically Delhi suffers from extreme temperatures, extreme heat in summer and extreme cold in winter. Delhi has a population of around 9420,644 (1999) approximately out of which female per male ratio is 1000:827, urban population ratio 89.9%, total area of 1483.00sq.km out of which the urban area is 700.23sq.km and rural area is 782.77sq.km. Delhi has a literacy rate of 75.3. Since independence New Delhi has had a phenomenal population growth rate indicative of its appeal to new migrants resulting in a population rise from 4.1(1 lakh=100000) in 1911 to 134.2 lakhs in 1999 and estimated to rise to about 224.2 lakhs by 2021 A.D if it continues to grow at this rate. In-migration is one of the main reasons for the growth of population in Delhi and migrants account for 50% of the population increase every year. Delhi has a population of over 8.47 million today (Delhi Statistical Handbook, N.C.T.D, 1994, www.unchs.org). Given in table 5.1 is the population estimate at five-year intervals according to a government report (Delhi a fact Sheet, Government of India report, 1999).

Year	Population in Million
1982	6.22
1986	7.52
1991	9.1
1996	10.7
2001	12.8

Table 5.1

DDA formulated a Master Plan in 1962, which was modified in 1990 with perspective up-to 2001. But due to the massive growth of Delhi in the nineties both demographically and spatially a further revision of Master Plan up-to 2021 is under preparation. One of the guidelines to achieve a balanced regional development was to restrict industrial growth to small scale, capital intensive, and low energy emitting and non-nuisance industries within Delhi. Given below is the perspective plan for Delhi 2001 (Delhi a Fact Sheet, Government of India report, 1999)

- Delhi to be planned as an integral part of its region
- Ecological balance to be maintained
- The central city area to be treated as special area
- Urban heritage of Delhi to be conserved
- The city centre to be decentralised
- Mass transport system to be Multi-Model
- The urban development to be Low rise high density
- Urban development to be hierarchical

According to official concepts shelter for all was given priority to and government bodies like the housing and urban development corporation of India sanctions over 91% of dwelling units for the economically weaker section and the low-income group category and 8.34% for the middle and the high-income group (HUDCO, 1998) and is depicted in the figure 5.1 given in the flowing page.

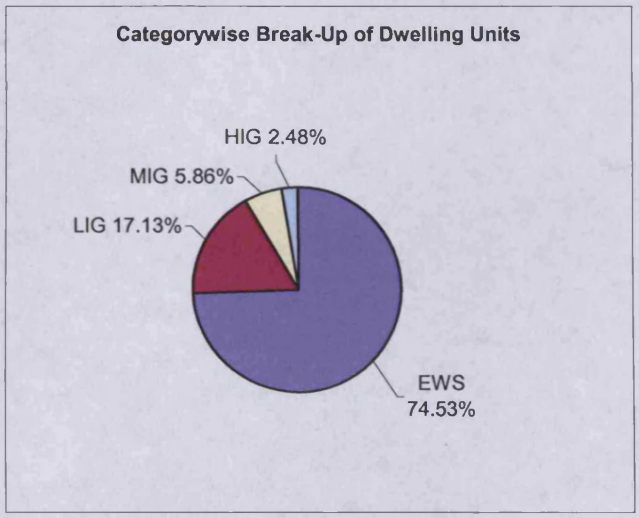


Figure 5.1

5.2 Aim of this study: to study the urban shelter and its processes in order to have a better understanding of shelter requirements and lifestyles among various income groups in order to gauge sustainability within the context of community needs and environmental impacts. These findings in turn will contribute towards recommendations made in Chapter VI.

5.3 Objectives of this study: to carry out three case studies in New Delhi and are as follows-

- **Stage B Case Study I:** Housing settlements in Basant Enclave a public housing for the middle income group (MIG) with household income of Rupees 7,500- Rupees 10,000 per month (source: HUDCO, 1998)
- **Stage B Case Study II:** Housing scheme of the low-income group and economically weaker section squatter settlement in Bhumeeheen camp for the economically weaker section (EWS) with household income of Rupees 2,100 per month or less and the low-income group (LIG) with household income above Rupees 4,500-Rupees 5,500 per month (source: HUDCO, 1998)
- **Stage B Case Study III:** Questionnaire survey of HIG housing units around Delhi of households with estimated income above Rupees 7, 500 per month (source: HUDCO, 1998)

5.4 Methodology: The following are the tool adopted for data collection

- **Questionnaire Set B**: Set B questionnaire (appendix 2) has been developed in order to test the set B hypotheses and which has been discussed in the methodology chapter and will be discussed a bit more in this chapter.
- **Structured Interviews of Households:** Set B interview questions (appendix 4) were developed with the aim of acquiring additional information from the respondents. The structured interview details of development have already been discussed in the methodology chapter.
- **Site Observations:** were carried out during the individual case study site surveys, along with the interview and questionnaire surveys carried out. Photographs have also been taken of the site and shelter, which have been used as visual illustration.
- **Analysis:** Most of the questions in the questionnaire surveys and the interview have been developed to provide quantitative outputs and presented in percentages in graphs. Open-ended questions are analysed qualitatively by converting responses into numerical codes.

5.4.1 Set B questionnaire: Questionnaire survey is the main tool used for data collection in this study

The main purpose of the questionnaire survey was to study the micro aspects of social, economical, environmental, technological and political factors of shelter from the users point of views with the ultimate intention of gauging shelter sustainability. The questions and their contents were guided by the hypotheses set B developed to be tested in this stage B case studies. Although shelter in general and respective aspects contain within it various issues and subjects for the purpose of this study focus is kept priorities found in the literature review and the stage A case study data collected. Focus is mainly kept on more general issues and their characteristics which are likely to have more direct impact on the user such as social and cultural needs and impacts on shelter, participation, cost of shelter, budget requirements, income levels and affordable shelter, comfort indicators, user inputs and building materials used. The data collected from the questionnaire survey is expected to contribute information, which may help determine areas with of scope for development and improvement in shelter conditions and user accessibility and participation in all areas

concerning shelter and user needs. Set B questionnaire has 31 questions and the questions are kept simple and precise and as far as possible scientific terms are avoided. Maximum number of questions were developed as close ended questions with tick boxes in order to draw quantitative results from them except for questions 13,31 and 32 are open-ended questions and the answers to these questions are post coded and analysed qualitatively. In most of the tick box questions, five boxes have been provided and based on the general suggestion that use of odd number of steps allows the respondent to express a fair or neutral strength of opinion. Although this approach can lead to the respondent refusing to express an opinion and choosing the middle category for all questions however the alternative approach can be worse where the respondents who have no or neutral opinion and have to choose from negative or positive and do it randomly (www.analytictech.com)

The questionnaire begins with a short introduction to the aim of the survey and a set of instructions are given on how to fill the questionnaire along with the researcher's contact number for any further queries.

The set of social aspects questions have been developed in order to help determine user preferences and priorities areas concerning shelter choices, location, their level of participation and their requirements from shelter in order to help determine whether the absence or presence of user participation has any influence on the successful provision of user requirements and their satisfaction. The set of questions concerning economic aspects look into expected present shelter costs for different income groups and compare it with running energy costs of the respondents, shelter expenditures incurred by different groups and on what mainly maintenance or heating/cooling costs, budget and shelter type expected in order to find out more about shelter affordability levels among various income groups, what kind of shelter they expects and in general the influence of funds on shelter. The set of questions concerning environmental aspects have been developed to help gauge user priority areas concerning comfort, their satisfaction levels and their dependence on additional systems to achieve comfort mainly thermal comfort in order to study comfort in relation to user needs and energy use. The set of technological questions have been developed to gauge materials preferences and satisfaction levels with the intention of finding why certain materials have been adopted and gauge possibilities of success for alternate options. Additional questions general awareness levels, health and any changes the respondents would like in their shelter units.

Barriers encountered: Although the questions are kept simple, some terms have proved difficult for some respondents to understand evident in low response to certain questions. Also very few respondents have attempted the open-ended questions and therefore these questions have been considered null (Q 17,31). Another problem encountered was that the questionnaire survey could not be conducted through random distribution in the LIG/EWS squatter settlement study in stage B case study as the literacy rate in the sector in very low thus the questionnaire survey was conducted face to face in Hindi and translated to English during analysis. During the face-to-face questionnaire survey, the set of structured interview questions have also been used. All the tick-box questions are categorised and number coded and the open-ended questions are numerically post coded and converted to percentages and depicted in tables and graphs.

Also additional information collected for the three case studies were not consistent all case studies were not documented to the same extent. Therefore one case study might have more background information than the other. The materials acquired have been used since it contributes to the understanding of the particular shelter types.

5.4.2 Set B structured interview questions:

The interview questions have been developed mainly in order informally gauge respondents views on the quality and comfort of their shelter units, their awareness levels, use of passive systems, recycling, energy use and shelter costs and find out more about their lifestyles, shelter needs and concerns. The data collected has been used to in some areas support the questionnaire findings. During interview noted were used to record data collected and where agreed upon tapes have been used (a small number) and transcribed during analysis.

Figure 5.2 below explains the structure adopted in the three case studies:

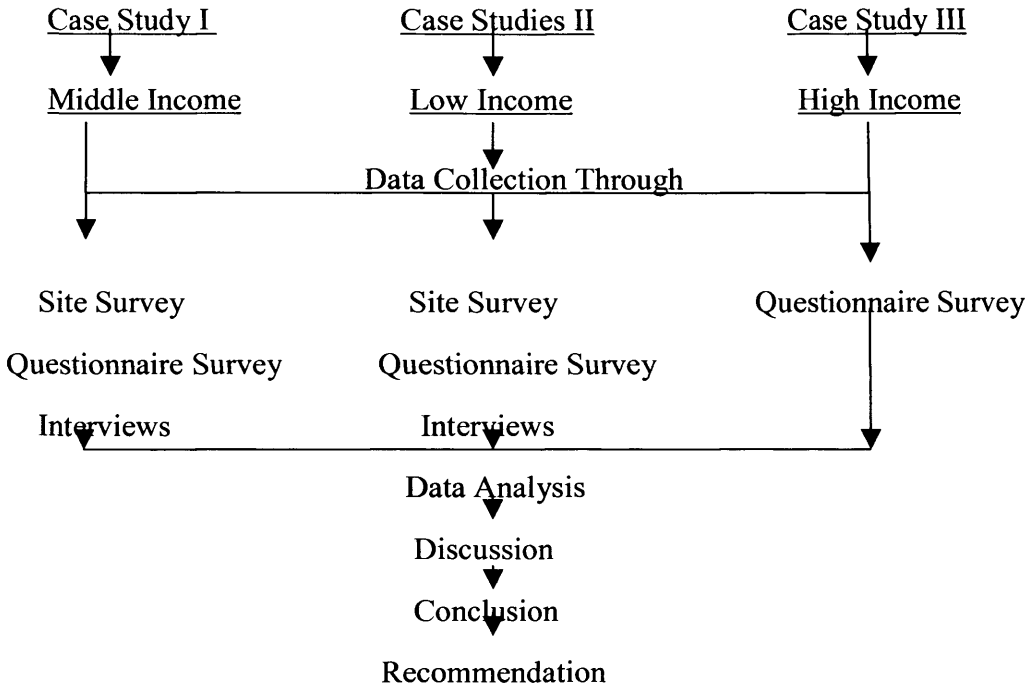


Figure 5.2

5.5 Stage B Case Study I

New Delhi- Middle Income Group Housing, Self-Financing Scheme 77-78 under the Delhi Development Authority

5.5.1 Introduction: Case study I conducted is of public housing units in Basant Enclave in New Delhi. This case study was carried in the month of June and July 2002. This development has flats, which cater mainly to the middle-income group households (developments like this one also offer instalment payment scheme distributed over a period of time). As mentioned earlier the data collection tools used are mainly questionnaire surveys (100 questionnaires distributed in this settlement with a response rate of 47 numbers) and structured interviews conducted (10 numbers) during the site visit surveys.

Background on Delhi Development Authority:

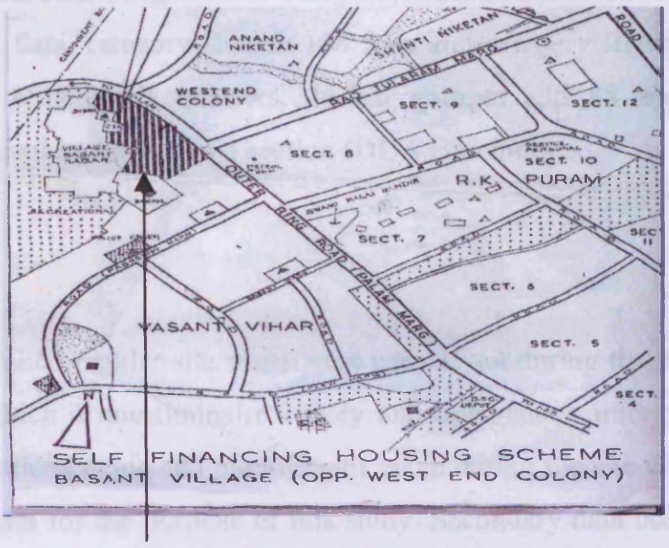
Delhi Development Authority (DDA) India's first development authority was constituted in 1955 to plan and execute the development of Delhi, provide shelter and infrastructure facilities to its existing population and also to make provisions for future growth.

According to a report DDA had to plan and implement an integrated development strategy, which was to be cost effective and at the same time functionally utilitarian, environmentally sound, and aesthetically appealing, preserve the rich heritage of the city while catering to the fast and complex scenario of the future. DDA owns around 64766.85 acres of land in New Delhi designated of housing, infrastructure services, commercial, industrial and recreational activities. DDA started constructing flats in 1968 and have floated 28 housing schemes from time to time for various income groups. Up till March 2001 DDA has constructed and facilitated construction by giving land to individuals, cooperative societies and resettlement colonies and around 1.40 million dwelling units, 60% of which have been for the EWS and the LIG. At present due to resource limitations the public sector is now promoting more private sector participation in shelter construction and infrastructure on a large scale and a policy for economic liberalisation was stated in 1998 (www.urbanindia.nic.in).

5.5.2 Location:

This site shown in figure 5.3 in the following page and is located on the outer Ring Road in the North of village Basant and on the west of Vasant Vihar where the pilot studies I was conducted. It is in the close vicinity of popular MIG and HIG residential areas such as Westend, Anand Niketan and Shanti Niketan. This site is easily approachable from domestic Palam Airport, International Indira Gandhi Airport and from New Delhi central commercial and official areas via Rao Tula Marg.

Basant Enclave development in New Delhi was selected for a case study because DDA officer interviewed during the stage A case studies suggested this developments was an ideal example of an MIG development in terms of good value for their money, easy accessibility and close proximity of the location to services like hospitals, schools and the airport. The other reason was that this site was easily accessible being on the main road and could also be easily be located.



Site

Figure 5.3

Site Plan: The site plan of this development is given below in figure 5.4

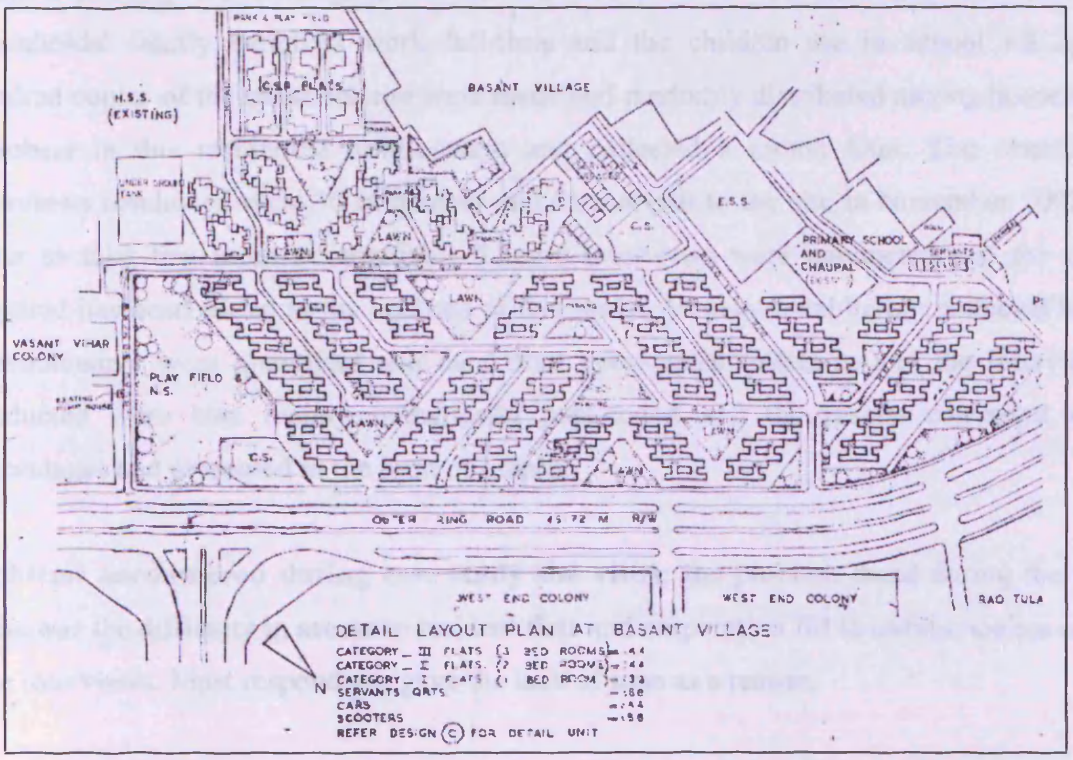


Figure 5.4

Site visits establish that the area has provisions of basic community facilities like the availability of shopping, schools and health facilities at close proximity. This development

is a composite scheme consisting of three categories based on the number of bedrooms and category I with 132 flats, category II with 144 flats and category III with 420 flats along with provision for 88 helper's quarters, 44 car garages and 88 scooter garages and discussed in more detail in the analysis section (DDA Brochure).

5.5.3 Procedure:

As previously mentioned regular site visits were carried out during the months of June and July 2002 during which a questionnaire survey and open-ended interviews were used to collect data. Observations made and photographs taken during the site visits have also been used as additional data for the purpose of this study. Secondary data used in order to back this study is from published official data collected from site visits to DDA departments.
Site visit surveys were conducted mainly during evenings, the reason being that most household members were out at work during the day. In addition evening cooler and more pleasant to carry out investigations of the site and interact with residents. In most MIG households' family members work full-time and the children are in school till 2pm. hundred copies of the questionnaire were made and randomly distributed among household members in this residential development and collected a month later. The structured interviews conducted were 10 in number and on a revisit to the site in November 2003 in order to take few more photographs, 5 more interviews were conducted and the data acquired has been added to the analysis of this study. As mentioned before collected back questionnaires were quantified and data from open-ended questions and the interviews conducted were also mainly numerically post-coded and the results converted into percentages and presented in the form of graphs.

Problems encountered during case study site visits: the problem faced during the site visits was the difficulty in access to resident flats and corporation fill in questionnaires or to give interviews. Most respondents gave the lack of time as a reason.

5.5.4 Analysis: In this section four aspects of this shelter development will be investigated using a set of questionnaire and structured interview question responses to test the hypotheses developed. The photographs taken have been used to illustrate the physical

properties of this development. The data gathered in the questionnaire and interview surveys along with additional secondary data relevant to this assessment have been used.

Description of House Type:

Low-rise settlements: Ground level or up-to ground plus two can be categorised as low-rise and this development the units are ground+2. According to the perspective plan for Delhi 2001, all developments in Delhi are to be low-rise high density. Low- rise houses are generally load bearing structures and can be constructed using materials like bricks, cement, timber, mud blocks and other locally available materials and is capable self-help construction. The provision for incremental growth can be achieved in low-rise settlements and hence families can make additions to their dwelling areas as their economic status and family grow.

According to Charles Correa "If the housing we build takes the form of high- rise buildings, then it will involve only the few construction companies who can build those kinds of buildings, and the very few architects and engineers who design them, and also the handful of banks who finance them. If the same amount of finance and resources were invested in low-rise buildings, thousands of jobs would be generated for the entire masons and carpenters etc, in the bazaar sector of the economy, thus doing more good for the new migrants. Low-rise buildings are more malleable and can easily express the identity and the cultural values of the occupants" (Housing and Urbanisation, 1999)

Details of the flats and other design features:

Basant enclave is a low-rise (g+2) housing complex. This residential area was built by the public sector, the Delhi Development Authority to cater to the Middle Income Group. The building materials used are bricks and cement and the exteriors walls are painted in white as seen in figure 5.5, 5.6 and 5.7 given in the flowing page.

Figure 5.5

Figure 5.6

Figure 5.7

In this development the flats are of three types and their description are given below:

Category-I flats (source: DDA publishing):

These flats have been planned in three storey blocks with independent category-I units on each floor served by a common staircase. The accommodation includes one living room 2.8M X 3.4M, one bed- room 3.8M X 2.8M, kitchen 1.8M X 2.8M, bath 1.5M X 1.3M, WC 1.5M X 1.0M, Veranda: 1.9 M Wide and a lounge 2.4M X 3.4M with a plinth area of 53.18 Sq. Metres on the ground and 57.26 Sq. Metres on the first and second floor. For the ground floor, internal and external courtyards have been provided, on first and second floors open terraces have been created for outdoor sleeping and scooter parking area of 1.0M X 2.7M for 1st and 2nd floor only.

Category-II Flats:

The category-II flats are located in the composite three- storey block with category II flats on the ground floor and category-III flats on the first and second floor in the form of duplex. The accommodation provided includes one drawing room, two bedrooms, kitchen, two toilets, lounge, internal courtyard and a private lawn in the front with a plinth area of 94.70 sq. Metres. Figure 5.8 in the following page shows the plan of a two bedroom flat.

Category-III Flats:

These are three bedroom units that are planned on first and second floor in the form of duplex over category-II flats. The total floor area is approximately 134.24 sq. Metres. Comprising of 86.07 sq. Metres on the first and 48.17 sq. The first floor includes one drawing room, one bed- room, kitchen, toilet, store, lounge with staircase leading to 2nd floor and the terrace and the upper floor includes to bed-rooms, a toilet, a WC and two terraces towards the front. An independent staircase leading from the ground to the first floor serves each category-II unit. According to the planners, while designing all the three categories of flats, special care was taken in order to integrate the various spaces so as to make their optimum use, thus eliminating completely dead spaces in the flats. The rooms have been arranged in order to create a family environment and intimacy within the family, without affecting the individual's privacy.

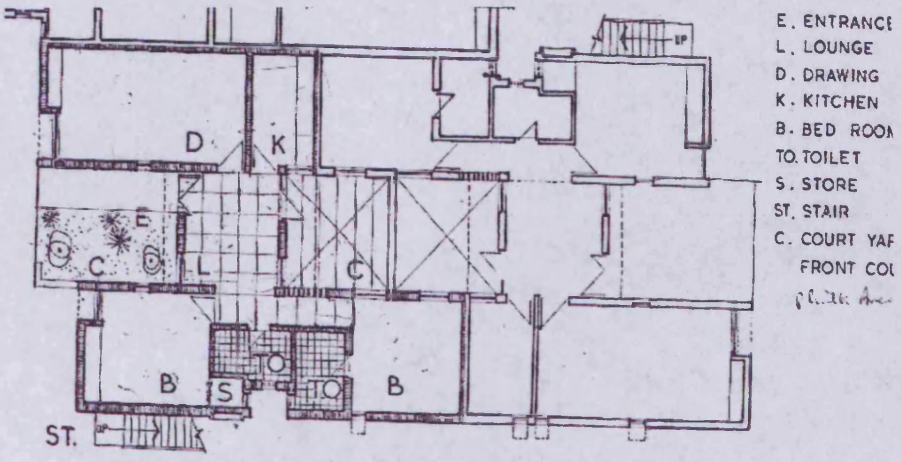


Figure 5.8- Plan of a two bedroom flat

Figure 5.9, 5.10 below and 5.11 shows the indoors of a residential unit in this development taken during the site visits.

Figure 5.9

Figure 5.10

Figure 5.11

Social Aspects: In this sections user preferences and priorities concerning shelter choices, location, their level of participation and their requirements from shelter will be studied. Information provided by the DDA official during the interview suggests that the units have been executed entirely by the DDA planners based on their understanding of user requirements. The analysis will help determine whether the absence of user participation has any bearing on the successful provision of user requirements, their satisfaction and their quality of life.

(This development is mainly a lower and higher middle-income development belonging to the professional working class and among the respondents was also retired government servicemen who have lived most of their service life in government public houses).

Social Hypotheses *There is a relationship between user participation, preference and needs inputs in house planning and user satisfaction*

Questionnaire survey data:

Respondents' responses on the areas concerning shelter they thought needed attention

In response to the questionnaire question about what was wrong with the shelter system from the options given a larger percentage of the respondents ticked thermal comfort among other factors such as planning, maintenance problem, space and cost of air conditioning need attention and is shown in the figure 5.12 in the following page.

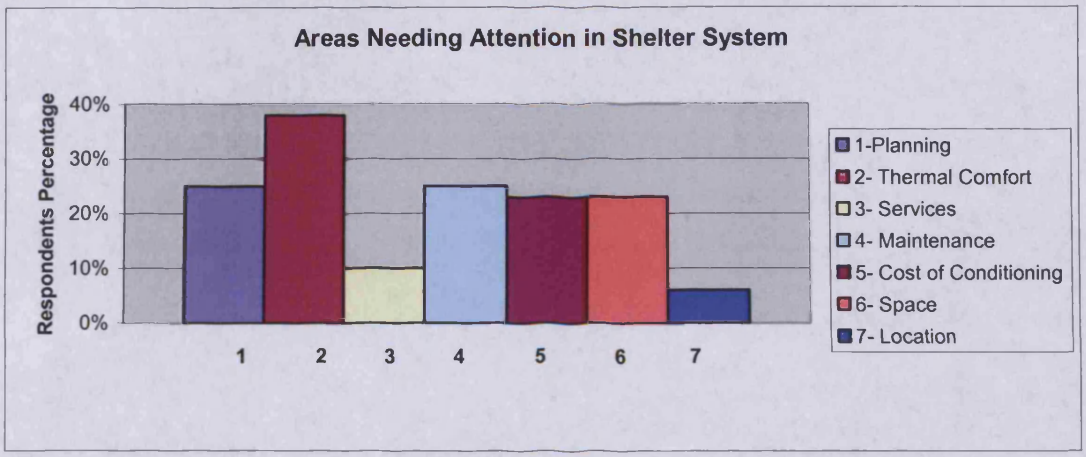


Figure 5.12

Incorporation of user needs in their units

In response to the question on whether the respondents felt that their needs and preferences were taken into consideration and incorporated in planning and design of their shelter units a larger percentage of the respondents ticked no. The results are shown in figure 5.13 below.

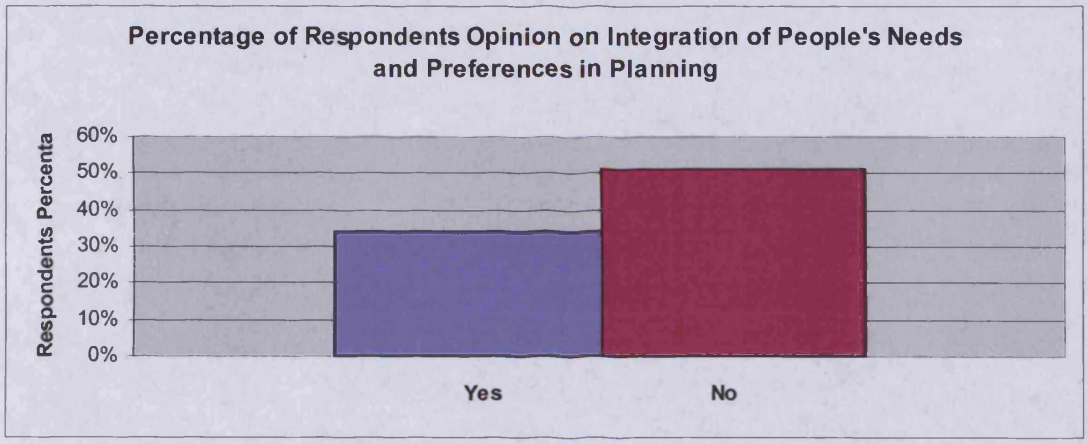


Figure 5.13

User preferences and priority reasons concerning the choice of a this particular shelter:

In response to the question on priority reasons for choosing this shelter from the options given, most respondents ticked location of the shelter development, as compared to the cost of the unit, comfort or aesthetics value. The results are depicted in the figure 5.14 given

below. The site surveys show that this housing development is very well located, close to the centre of the city and to all-important amenities. Also in response to another question which queried on the good points of their home, many respondents wrote about the location advantage, it proximity to essential services. This development is situated on the main road and thus with good transport network links through busses, rickshaws, taxi and now the underground metro as well provides good accessibility.

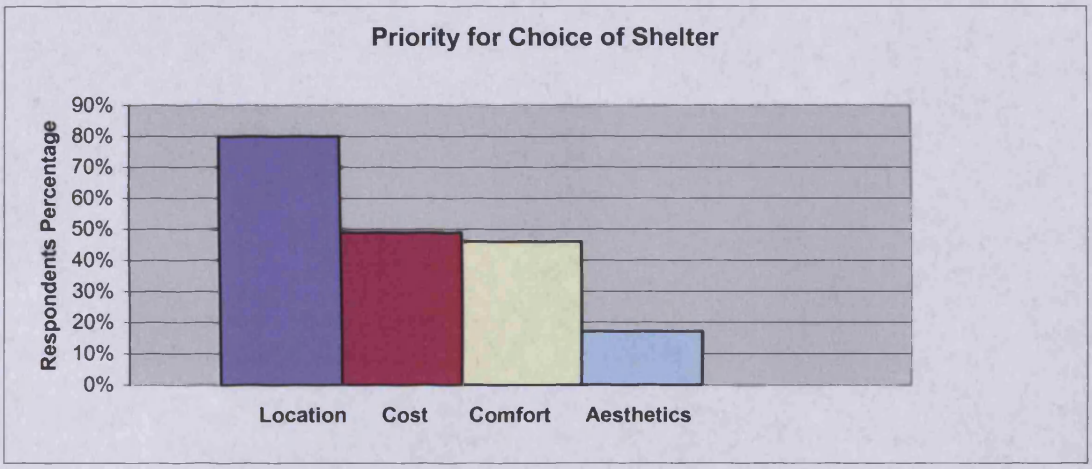


Figure 5.14

In response to the question on what the reasons were for their choice of location for a house from the options given a higher percentage of the respondents ticked near facilities like shops and schools, good transport services and lesser congestions. A smaller number ticked proximity to workplace, near family and friends and greenery. The results are shown in the figure 5.15.

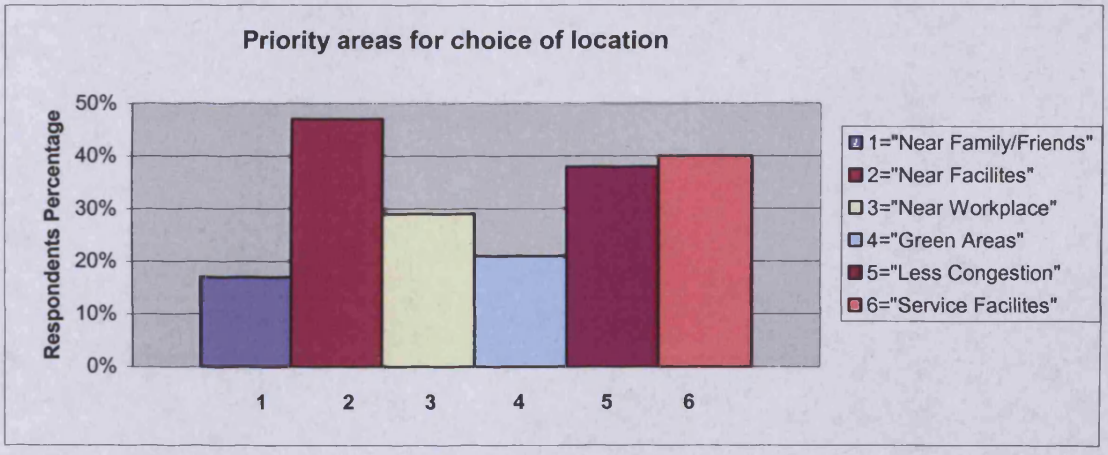


Figure 5.15

In response to the question on what properties the respondents looked for in a house from the options given, 85% ticked general comfort, 80% ticked space, and 72% ticked privacy and cost effectiveness. The areas with lower priorities, less than 50 % votes, were communal playgrounds and energy efficiency. Building materials used got lowest priority and only 12% ticked traditional materials and shown figure 5.16 below.

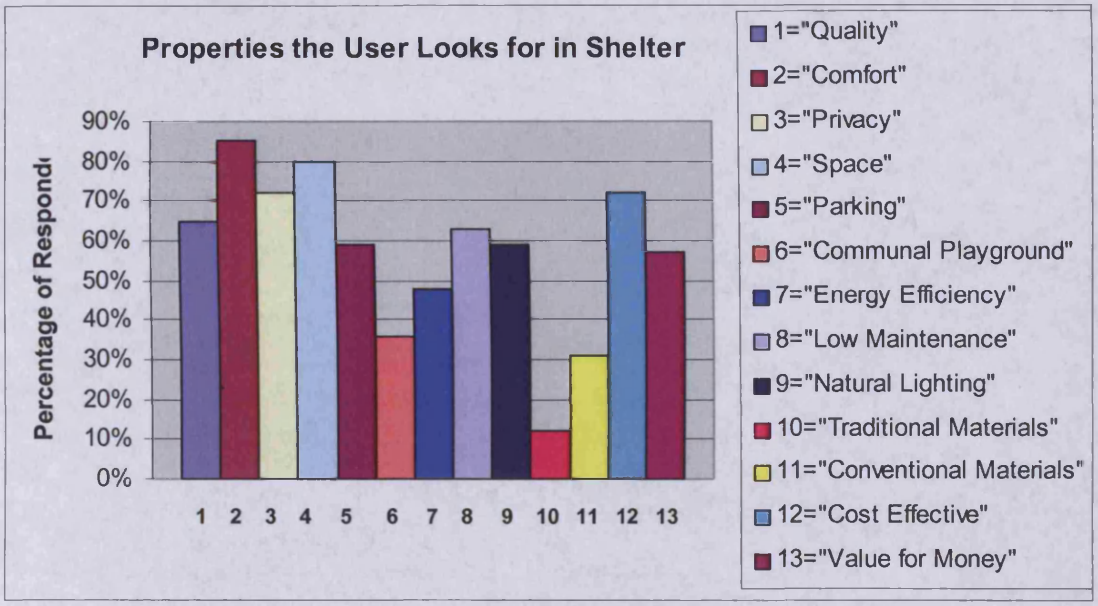


Figure 5.16

The following graphs are intended to show user satisfaction levels and they're rating of various aspects concerning general comfort, indoor space, privacy, services and quality. In order to gauge whether priority areas identified by users are satisfactory or not the results in the following graphs will be compared with the results in figure 4.16 in the previous page.

Comfort: table 4.16 shows that 85 % of the respondents consider comfort an important aspect in a house. In response to the question on whether they were satisfied with the general comfort conditions of their house a larger percentage responded yes shown in figure 5.17 in the following page.

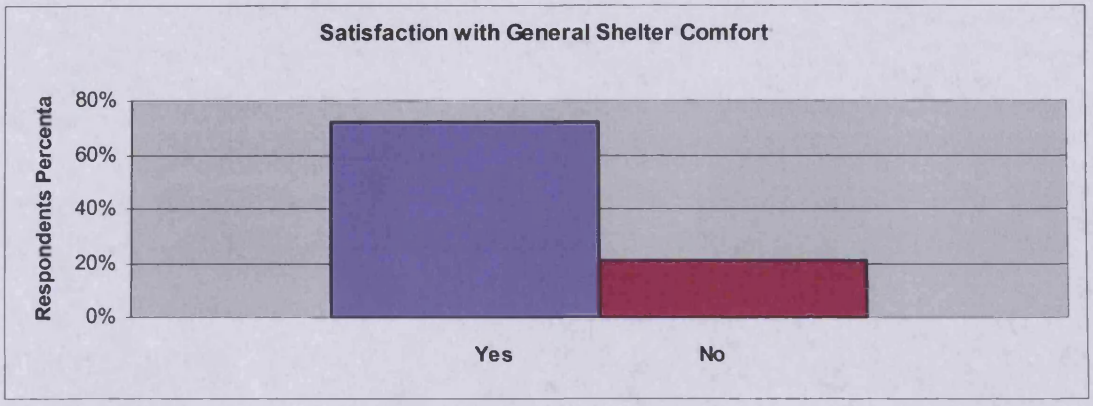


Figure 5.17

Space: A large percentage gave importance to the provision of adequate space and expressed satisfaction and is depicted in figure 5.18.

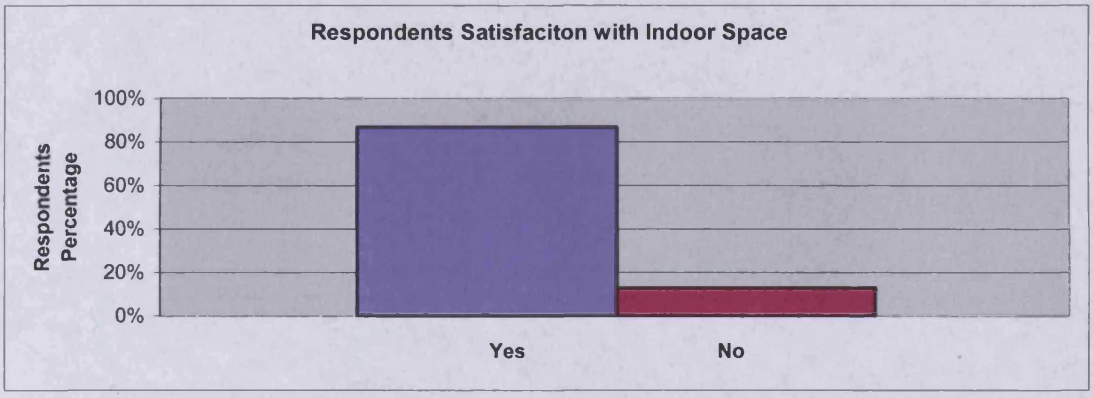


Figure 5.18

Figure 5.19 given below shows how people have created additional space such as rooftop terraces.

Figure 5.19

Service Provision: has also been one of the priorities among respondents and in response to the question on service provision a larger percentage of the respondents showed satisfaction and is shown in figure 5.20 given below.

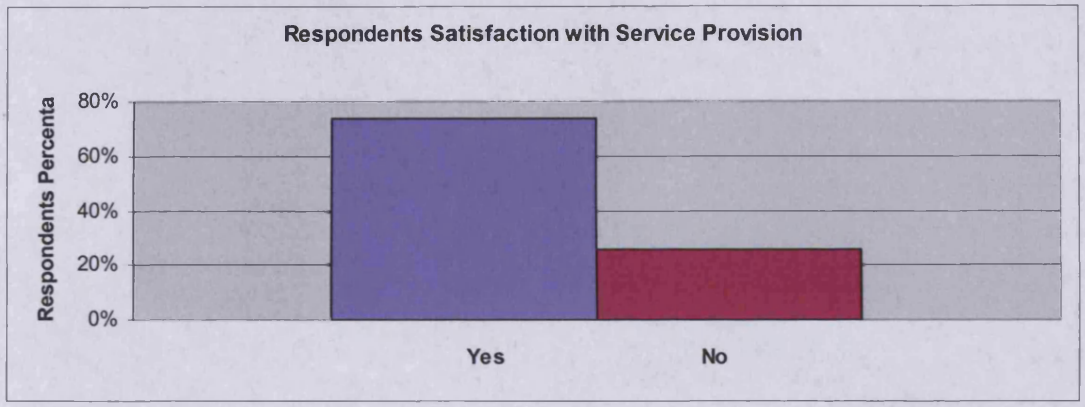


Figure 5.20

Privacy: has also been rated as an important aspect by 72% of the respondents and in response to the question on how they rate privacy in their houses on a scale of 1 to 5 where one is very poor and 5 excellent, 14% have rated it as poor, 21% as moderate and 56% have rated it as good and excellent. The results are shown in figure 5.21.

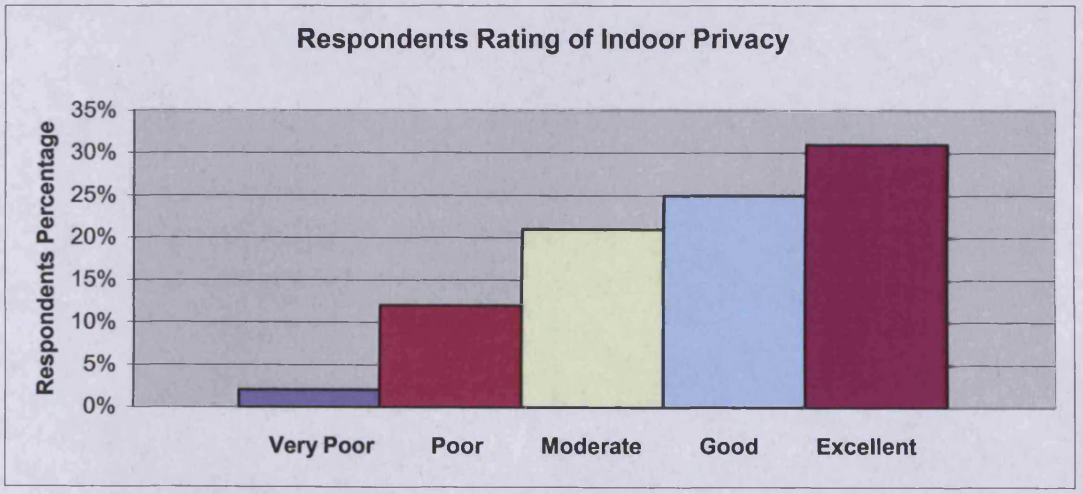


Figure 5.21

Quality: 65% of the respondents considered quality in a house as important. In response to the question whether the quality of their house was satisfactory on a scale of very poor to

excellent, 48% rated it between good and excellent, 29% rated it as moderate and 21% rated it as poor and is shown in figure 5.22 below.

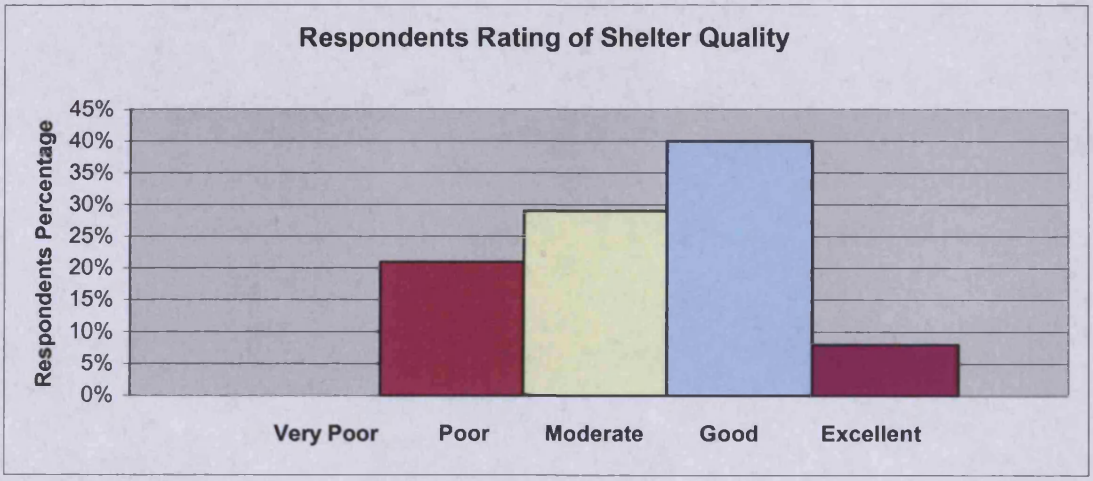


Figure 5.22

The graphs given above show that the aspects respondents have given priority to in a house are satisfactory in their house as well.

Additional data acquired from the interview survey:

Quality: In response to the question on how they felt about indoor comfort, all 15 respondents responses were ok.

Comfort: In response to the questions on what they felt about the quality of their shelter all 15 responses were good and ok and all the respondents have no particular complaints except for one respondent who felt the construction was not up-to the mark and narrated an incident about his neighbour drilling a nail his side of the shared wall and the bricks fell into his side of the flat leaving a hole on the wall.

Recycling: In response to the question on recycling, all 15 interviews respondents mentioned the informal rag collectors who come by often to collect domestic waste mainly newspaper, tin cans, bottles and other plastic and metal good that can be recycled in exchange for money or kind.

DDA official interview data: In addition during the interview with the DDA official, to the question on user participation in the planning and execution of the development the DDA official responded that the houses were mass executed and planned by the DDA

architects and the flat were advertised after, although space was optimised and all spaces were designed in order to comfort and privacy to the households.

Site observations: In this development as well many households have extended living spaces where possible covering the balconies to use as store/study and most of the top floor houses have added additional rooms on the terrace despite the building regulations that prohibit additions of more rooms in public flats due to safety reasons. (Most Indian families live as extended families and as the family grows there arises need for extra space to accommodate more people and despite the heavy warnings of population explosions a large number of Indian families have two children or more depending on the capacity to support them. And although joint family system is gradually being replaced by nuclear family system, large joint families living under the same room is still very common in rural as well as urban India).

Figure 5.23 and 5.24 show some pictures of the quality and general condition of houses in Basant Enclave.

Figure 5.23

Figure 5.24

In this study the units have been mass executed and planned by the DDA planners, with certain criteria which have been adopted in the plans such as special care was taken in order to integrate the various spaces so as to make their optimum use. The rooms have been arranged in order to create a family environment and intimacy within the family, without affecting the individual's privacy. From the questionnaire and the interviews, a larger percentage of the respondents are satisfied with their units including quality, privacy and space. In this study absence of user participation has no bearing on the satisfaction of the respondents.

Similar to this housing most MIG shelter developments the public sector is in control of choices in terms of political policies and technological applications and not the user as all planning and execution is undertaken by the DDA and advertised for sale later. Which in this case should be used to an advantage by using the public sector control to advocate and implement shelter schemes that support cost-effective alternative materials and technology depicted in the figure 5.25 below. These application could be used as successful examples and advertise the materials and technologies to the HIG category. The saving made from the use of resource efficient and cost effective technologies could transferred and be used to support more LIG developments.

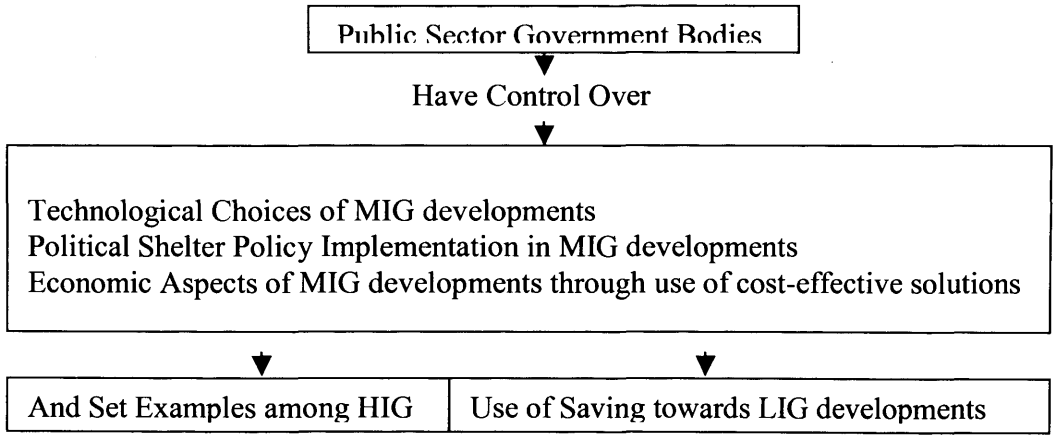


Figure 5.25

Economic Aspects: In this section the areas concerning present shelter costs, shelter expenditures, budget impacts, shelter value will be looked at in order to gauge present shelter costs, user expectations with respect to affordability. Also the based on additional

data collected a comparison is made between the shelter investment costs and ten years of running energy costs in order to gauge the likely scenario in household investments.

Economic Hypotheses *There is a relationship between affordability factor, present costs of shelter and access to shelter.*

Present shelter costs: In terms of economic status the middle-income group category falls between the low-income group and the high-income group. It and can be compared to the stage that lies between the developing and the developed world. According to data collected till date the public sector has been responsible for most MIG housing like this case study housing. Private houses built by private builders and architects have till date only been affordable to the HIG section of the urban community. However this trend is gradually is changing and private sector builders are also now getting more involved in MIG housing developments. More and more private sector housing units are coming up in the extended areas of Delhi like Gurgaon and Dwarka at more affordable prices and also catered for the MIG households.

In the case study 49% of the respondents felt that cost was a priority for choice of shelter. Although the estimated costs when the units were first planned were around rupees 1,15,000 lakhs, obviously present costs of these houses have risen. According to respondents at present the flat units minimum cost price start from around rupees 30,00,000 lakhs (£42875) and rise depending on the number of bedrooms and fittings. However the average incomes of household have not risen in the same way. According to official report of 1998 on average income of different income groups the average incomes of MIG households range from Rupees 7,500- 10,000 (£125 approximately) which are unlikely to increase much (HUDCO, 1998). In order to generate money to afford shelter at present costs these households would have to invest more than 20 years of annual savings. Hence in order to make shelter more affordable to household most housing schemes private and public adopt options such as instalments payment schemes. However study of the materials used suggest that option of making houses more affordable to the masses by actually reducing the cost price by adopting cost-effective technologies and materials has not been adopted in this housing development.

Questionnaire and interview survey data

Value for money: The above discussions seem to indicate that shelter is one of the biggest investments of a household. In response to the question whether their house investment had been a good value for their money most respondents responded yes and the results are shown in figure 5.26. The responses indicate that most respondents are satisfied with what they have invested in.

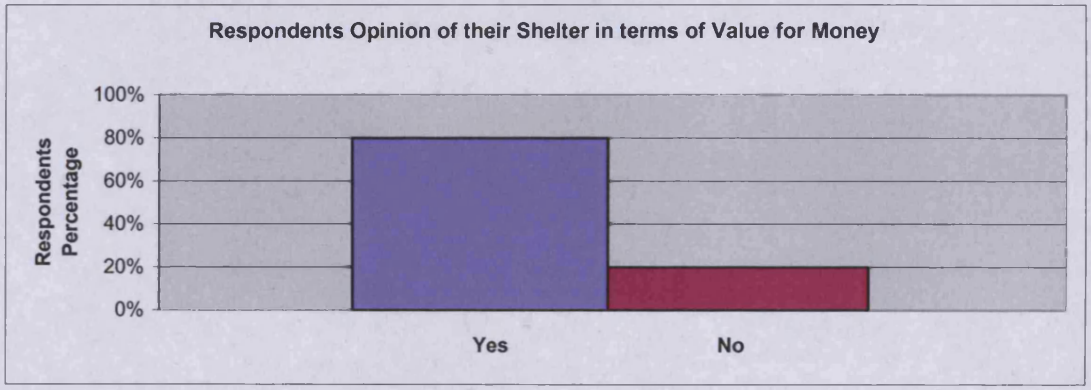


Figure 5.26

Impact of budget: In response to the question on whether the respondents thought that budget affected the planning and choice of materials used, a larger percentage of the respondents ticked yes and this is shown in figure 5.27 given below. This seems to indicate that in this housing most people think that the budget influences shelter quality and shelter type. People feel that low budget would give less. However this is not case since fewer budgets if effectively managed can provide the same results and has been successfully demonstrated in stage B case study II.

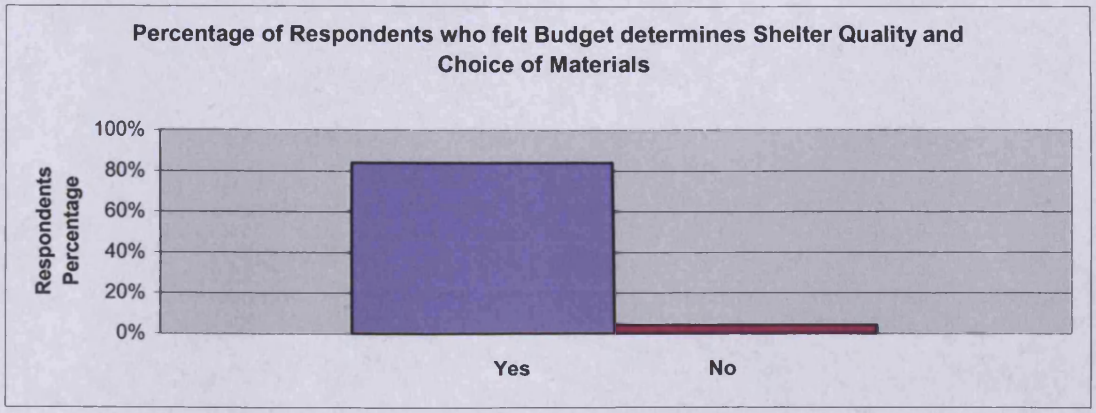


Figure 5.27

Proportion of investment put into their house: In response to the question on what proportion of their income the respondents spent on their house from the options given, a larger percentage ticked 10-15% and the results are shown in figure 5.28.

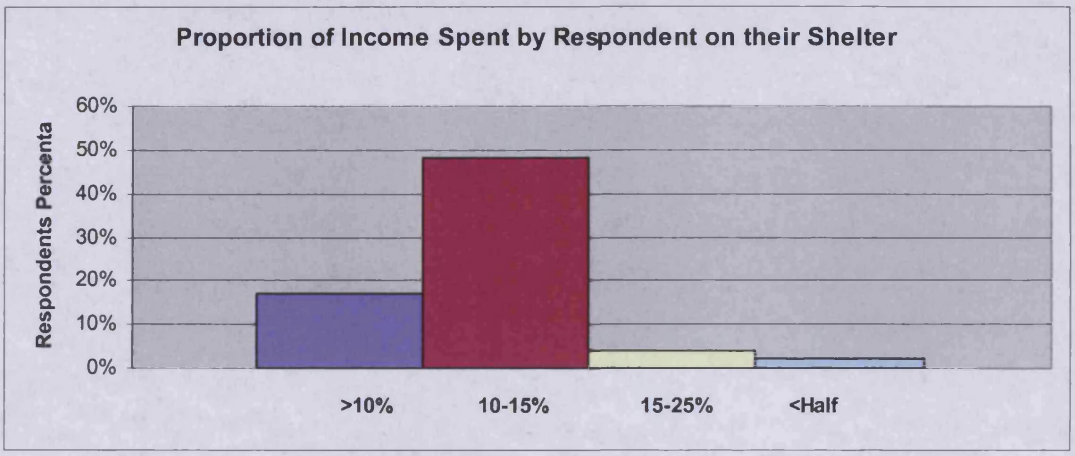


Figure 5.28

In response to the question what they spent their income mainly on, a larger percentage of the respondents' ticked maintenance and the results are shown in figure 5.29 given below.

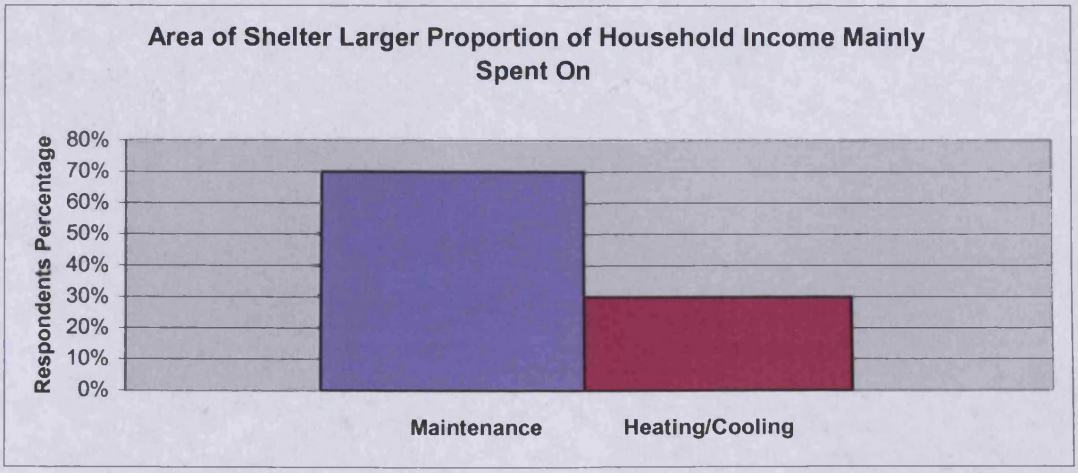


Figure 5.29

Investment Cost of Shelter Versus Ten Years Running Energy Costs: In order to further gauge shelter costs of a household, a comparison is made between the probable present investment costs of shelter and ten years of running energy costs. The graph is based on the data gathered from the questionnaire and interview survey data. The initial

investment is taken as 3000000 lakhs (£42875) the minimum cost a flat around the development (which can be paid in instalments). For monthly energy consumption costs the average based on the respondents response data is and Rupees 3000, and therefore the annual costs is taken as taken as rupees 36000 (£514 approximately). Rupees 36000 multiplied by ten in a period of ten years the household energy cost comes to Rupees 432000 (£5400 approximately). The difference in cost between two is evident in the figure 5.30 given below. Although the comparison between the costs of the units to the running cost is not an indictor of high embodied energy and lower running energy. The data gathered in the literature review on building materials and a look and the materials these units indicate a high-embodied energy. The materials used for this shelter development which are mainly brick and concrete are energy intensive in their production, while there are other alternative options available which are both energy and cost effective and they have not been used in this development (primary energy requirement of brick- 2-7GJ/ton, Concrete- 0.8-1.5 and precast-1.5-8 GJ/ton, UNCHS Habitat Energy for Buildings).

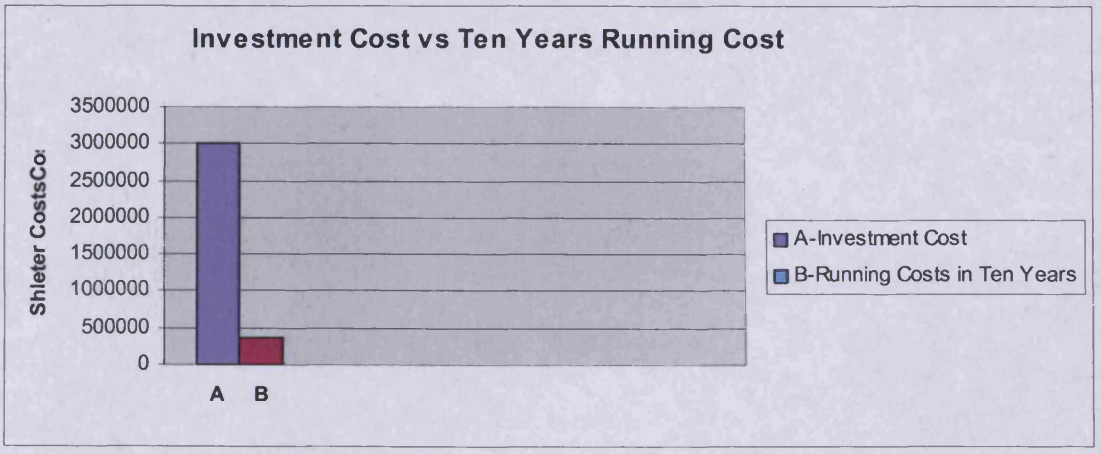


Figure 5.30

According to this study and indicated in the figure 5.30 in the previous page, the households invests a much larger percentage of their income and saving on their house in comparison to the long-term costs of maintenance and running energy costs. In this study, the planners have not used cost-effective materials but used the concept of mass executions and instalment schemes in order to make shelter more affordable to the middle-income group. However despite instalment schemes official reports on MIG incomes and costs of shelter indicated that some households might have to have to resort to loans and save for

years before they can afford a unit of their choice. Therefore mass execution and instalment schemes should be integrated with the use of cost-effective alternative materials and technologies in order to reduce construction costs and make shelter more accessible to more households in a shorter time span. The use of cost-effective technologies could result in savings and any savings made could be effectively channelled towards providing better community services and infrastructure. Also most of the cost-effective alternative technologies are based energy efficiency in production and transportation and therefore promote sustainable development.

Environmental Aspects: this section will look at respondents thermal comfort ratings during summer and winter, type of cooling systems adopted in order to gauge comfort and indoor thermal conditions and level of dependence on mechanical cooling. (According to data collected in literature review and personal observations in stage A case studies, most households use mechanical cooling, however heating systems have only started being adopted. Hence this study only looks at cooling systems used). The question on respondent's willingness to reduce dependence and use of mechanical systems if conditions improved through alternative ways was put into the questionnaire in order to gauge household mindset and willingness to adapt.

Environmental Hypotheses *There is a relationship between thermal comfort, energy use and shelter.*

Questionnaire survey data

User rating of indoor comfort: In response to question on how the rate indoor comfort in general on a scale of 1 to 5 where one is very poor and 5 is excellent a larger percentage rated it as moderate, good and excellent and is shown in the figure 5.31 given in the following page. This indicates that the respondents of this MIG housing are moderately satisfied with the comfort conditions of their dwelling units.

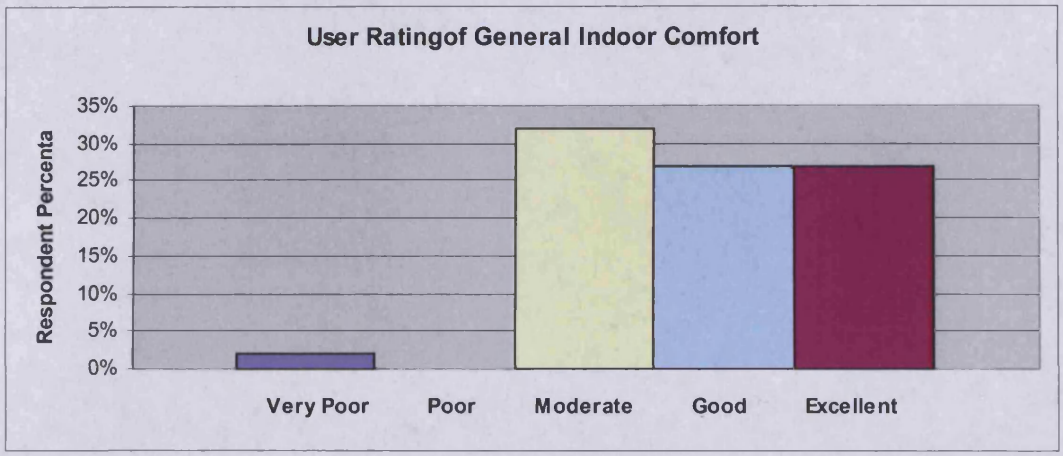


Figure 5.31

However to the question on rating indoor overheating, on a scale of 1 to 5 where 1 represents never and 5 represents always, a larger percentage of the respondents seemed dissatisfied. This is shown in the figure 5.32 given below.

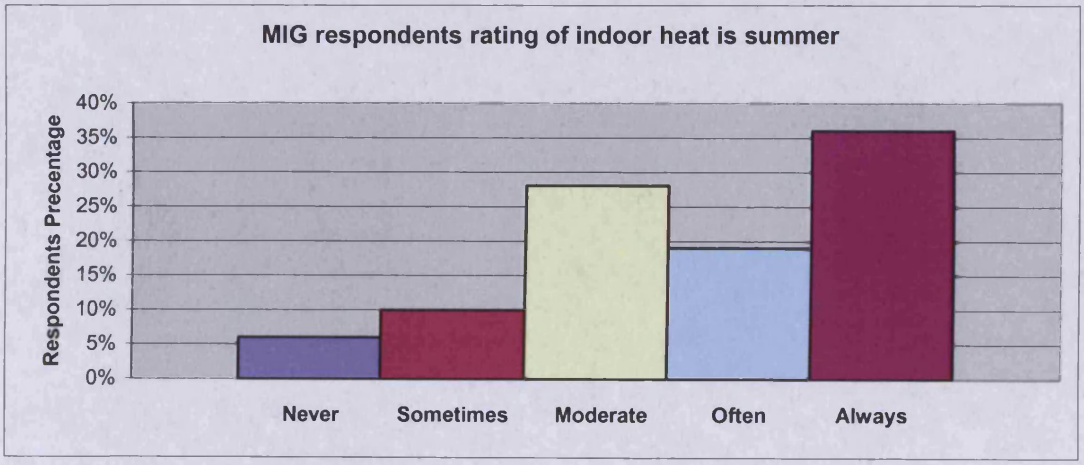


Figure 5.32

In response to the question on what type of cooling systems they use from the option given, all respondents ticked fans, also a larger number of the respondents ticked air-conditioners as well. Under the option of other, none of the respondents ticked, indicating that either no alternative cooling option has been adopted apart from conventional systems or respondents did not want to specify. Out of the 61% respondents owning air conditioners, 41% said they used it at night, 31% said they used it frequently and 28% said they used it occasionally.

The results are shown in figure 5.33.

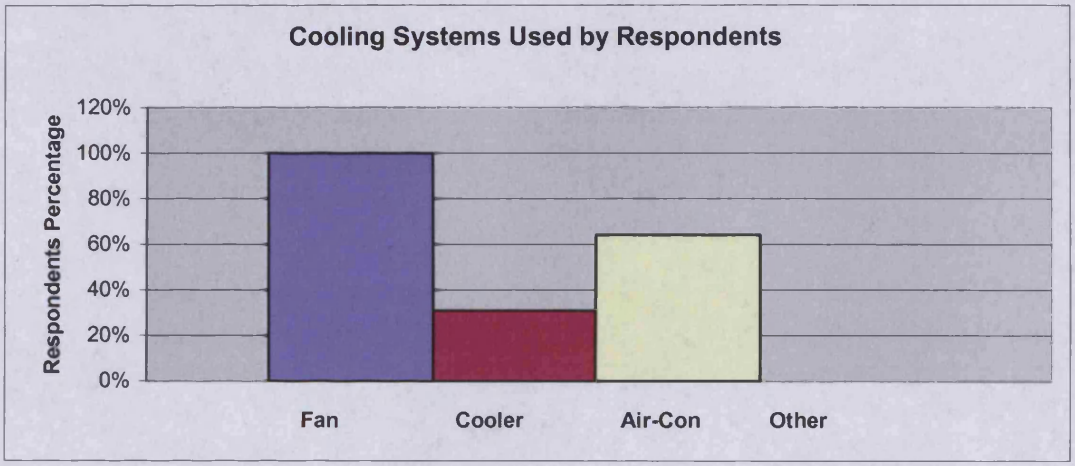


Figure 5.33

In response rating overcooling in winter to rating indoor comfort during winter on a scale of 1 to 5 where 1 represents never and 5 represents always larger percent of the respondents have ticked between 3 to 5 and is shown in the figure 5.34. This means that most respondents do not feel comfortable indoors during winter either.

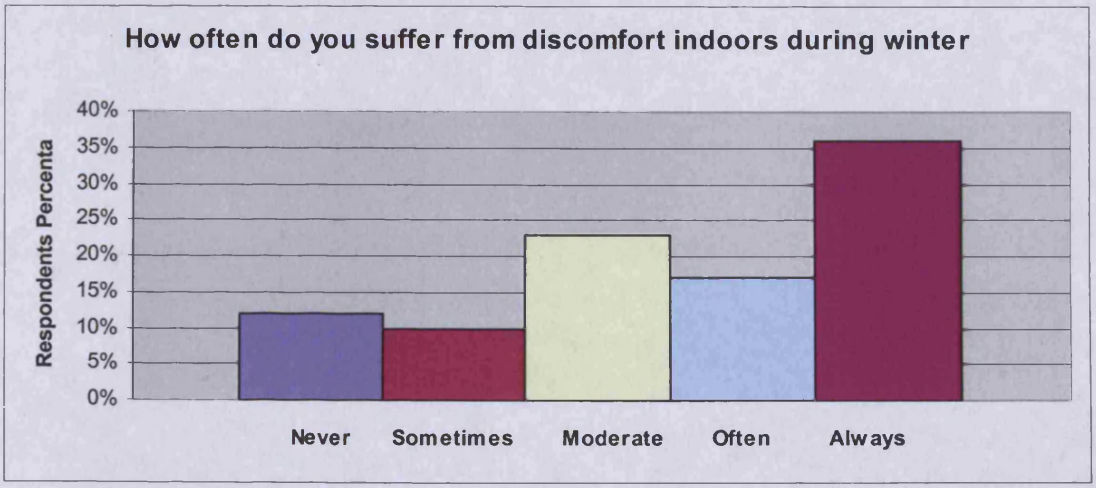


Figure 5.34

In response to the questions- if improved indoor comfort temperature was achieved through use of passive systems and planning would they reduce their dependency on mechanical systems, a large percentage of the residents answered yes. The results are depicted in figure 5.35 below.

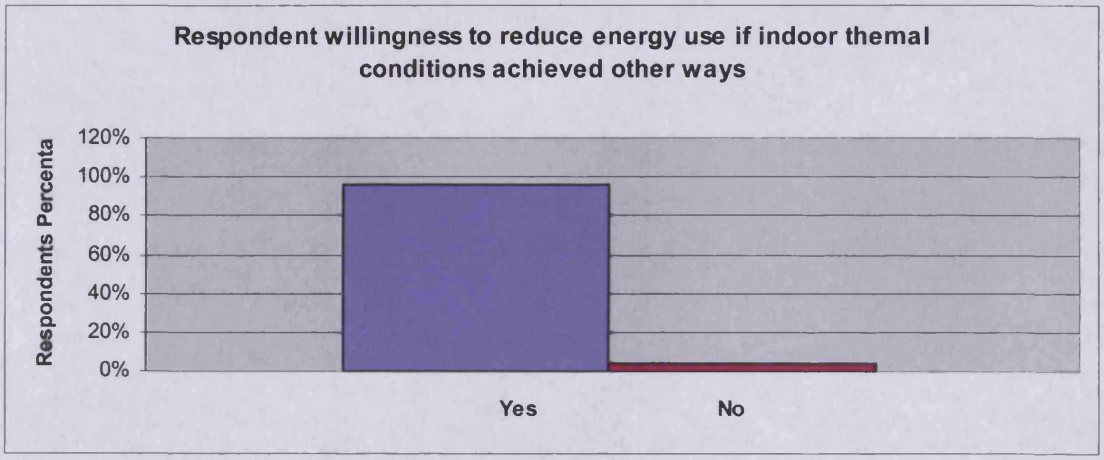


Figure 5.35

Interview survey data

In response to the question on awareness to passive systems in housing, all 15 respondents were aware of natural lighting and windows for natural breeze, 6 respondents were aware of the use of solar lighting and solar cookers, 10 of the respondents also commented on the use of shading devices.

Site observation: From site observations it is evident that ventilators and shading devices like adequate horizontal projections effective on the south facing windows are absent. Figure 5.36 and 5.37 show the type and shading used.

Figure 5.36

Figure 5.37

This study indicates that for most respondents their homes are not comfortable in summer and winter, of poor thermal comfort and are dependent on mechanical systems like fans, coolers and air-conditioners for comfort. And in response to the questions if given the option of improved indoor temperature through improved planning, maximum use of ventilation and climatically suitable materials and reduce dependency on mechanical systems, a large percentage of the residents answered yes. This indicates that user thermal comfort in this development is dependent on mechanical systems but users are open passive options if indoor conditions are comfortable. Based on the observations made during the site visits, the questionnaire and interview data gathered the lifestyle of an average MIG household in terms of energy use is likely to be as is shown in figure 5.38 which shows that the MIG households generally choose to live in public sector developments due to affordability. Since the main materials used are brick and concrete which at present are energy intensive in production due to inefficiencies. In terms of running energy use, a large percentage of households are dependent on mechanically aided systems mainly fans and air-conditioners.

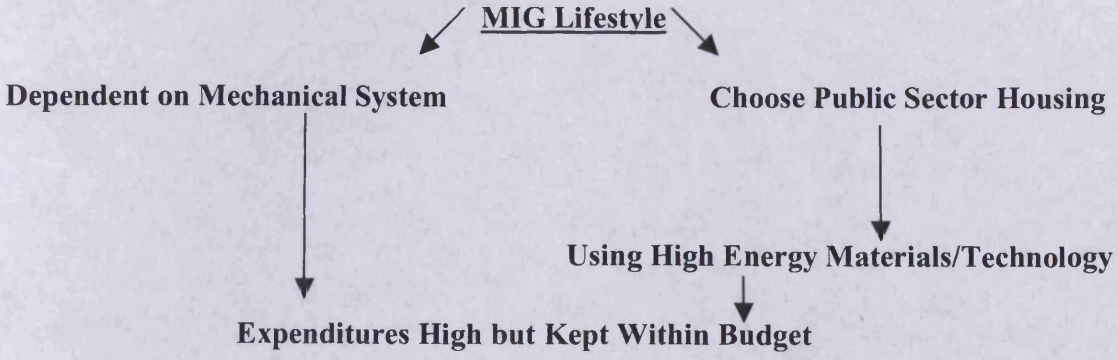


Figure 5.38 shows the lifestyle of the middle-income group

Technological Aspects: In this section the materials adopted, their properties and user preferences and satisfaction levels with the materials used will be looked at.

- **Technological Hypotheses** *There is a relationship between conventional building materials, appropriate building material technologies and shelter.*

Questionnaire survey data

The main materials used in these units are brick and concrete, all respondents were aware of these materials used in the construction of their homes. In response to the question on satisfaction with the materials used 68% said yes and 31% said no due to the bad quality of material used, inadequate soundproofing and thermal comfort. The results are shown in figure 5.39 given below.

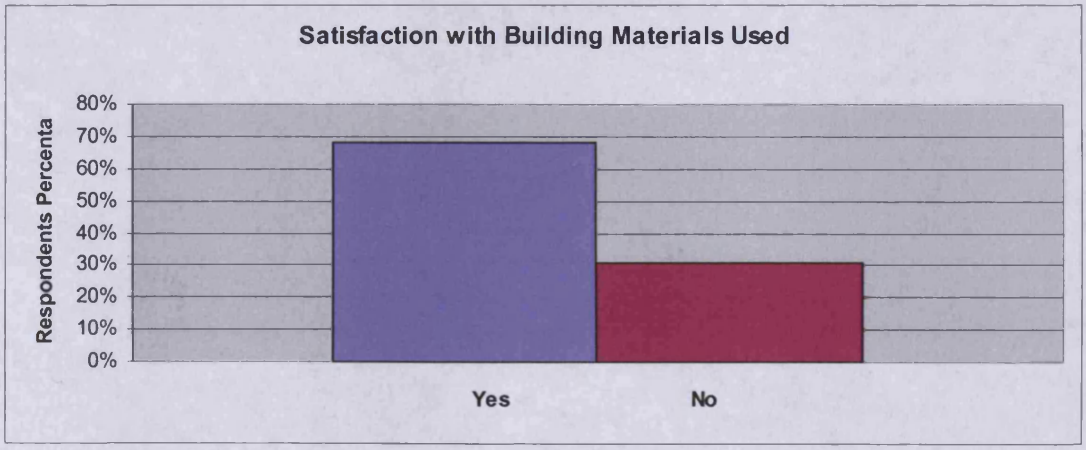


Figure 5.39

Gauging from the response of the respondents on the use of alternative options to improve indoor conditions, it seems that households of this housing sector are willing to adopt alternate options. Therefore most probably they would accept alternative energy efficient building materials as well if they were informed about the positive attributes. There are many alternative technologies available; they have not been applied in this development. At present these technologies are failing successful large-scale application and market acceptance. Therefore more surveys need to be conducted on the acceptability of new alternative materials and technology is required to gauge user preferences which can also act as a base for promoting and advertising these materials to the user.

Secondary written data:

As mentioned before the main materials used for construction in this development are mainly brick [1]and cement, which according to the literature review are energy intensive in their production. The production of bricks and concrete are energy intensive as the production units used is often outdated and inefficient, consuming a lot more fuel. From literature reviewed on energy used in construction in India, most of the power used in producing energy intensive materials, like brick and concrete, is obtained from coal, which has high carbon-dioxide emissions. CO2 emissions are generated in the extraction, manufacture and delivery, and it is the CO2 emissions that contribute to greenhouse gases that lead to global warming. The main fuel used for transport is also coal and hence the embodied energy content brick and concrete is likely to be high.

In the area of alternative materials a lot work is being carried out by institutes like TERI and Development Alternatives on systems that reduce energy use in brick and concrete manufacturing industries and adopting more efficient production technologies and units. This means that in future there is the likelihood that embodied energy content will go down. According to the DDA official, mostly brick and concrete are used in most developments however in recent developments hollow concrete blocks have been adopted in some developments by DDA. Literature review data shows that India has made a lot of progress in alterative technologies and building materials, which offer not only cost reductions but more energy efficiency as well as well and thus promote a sustainable shelter development. And yet due to social factors such as stigma and unacceptability and political factors such as absence supportive schemes and their implementation these technologies have not managed to infiltrate into the mass domestic market. For instance alternative building materials are being produced by research bodies like Central Building Research Institute, Roorkee (CBRI) and National Environmental Engineering Research Institute, Nagpur (NEERI) showing how houses can be built using various technology options and construction techniques using either the same material or alternative materials and build economically with savings of 20 to 40% over conventional costs. However despite creating building centres all over the country in order to transfer this technology from lab to land, these innovations have not achieved mass applications.

[1] Brick Making is an energy intensive process in India, the fuel costs alone account for 30-40% of production cost. It is estimated that Indian Industry consumes more than 24 million tons of coal annually, in addition to million tons of biomass fuels. Kilns are also highly polluting affecting flora, fauna and human

In order to address the gap between productions and dissemination 482 building centres have been set up all over India out of which 4 are in New Delhi. These building centres are engaged in the promotion and transfer of cost-effective technologies from lab to land, skill up gradation and training construction workers on cost-effective and innovative technologies and production and marketing of building materials and components. These centres have been set up to give guidance and counselling, information dissemination to general public and provide services to government, private, NGOs and other individuals in construction of cost-effective housing.

DDA official- In response to the question on recycling in construction the DDA official responded that at present use of new materials manufactured from agricultural and industrial waste are being experimented on and are in their initial staged of application.

5.5.5 Summary:

Middle-income respondents of this study favoured their shelter due to its location, in terms of transport networks, easy accessibility to services like hospitals, schools and market places and its proximity to the main government and business centres. The other influencing factor was cost; according to interview respondents due to the option of an instalment payment scheme many families have been able to afford a flat in this development.

The respondents have expressed satisfaction with the general quality and comfort of their units, however some dissatisfaction was expressed in the area of noise pollution. From site observations and the questionnaire responses it is evident that most households are dependent on mechanical systems especially for indoor cooling. In this study user awareness in the areas of energy efficiency in shelter is low resulting in energy intensive lifestyles. However a large percentage of the questionnaire survey respondents agreed that if the indoor conditions are improved using good planning and passive systems are introduced then they would choose this option and reduce mechanical system usage. Hence in areas like incremental growth, passive planning, alternative more effective materials and options in shelter could have been integrated into this shelter development if surveys on user needs and acceptance levels would have been pre-conducted. In additions their inputs on their needs, expectations and level of acceptance would contribute to better understanding of user needs by builders and planners.

Although the designers have integrated aspects of user needs like space and privacy, use of passive systems in planning like use of ventilators and adequate south window projections is not evident. Builders today need to focus on adapting to climate changes by switching over to more efficient and appropriate systems and materials combined with passive planning. These actions will help reduce cost and energy use in households. Also there is lot of scope and potential for implementation and application of alternative materials and technologies developed by research institutes in middle income shelter developments like these. Since these developments are mostly executed by the public sector they have total control over the choice of building materials and technologies adopted. These developments can set successful examples of alternative technologies in housing to other groups of the communities and private developers. Also the use of alternative cost and energy efficient materials and technologies should be made compulsory for these bodies through shelter policies and schemes.

5.6 Case Study II- Economically weaker and the low-income group in the squatter settlement in Bhumeeheen Camp in New Delhi

5.6.1 Introduction:

Case study II was conducted of squatter settlement Bhumeeheen Camp in New Delhi. This case study was conducted in the months of December 2002 and January 2003. Site surveys were carried out along with interviews (25 in number) using the questionnaire and the interview set B questions (most of the respondents were not well educated and those that were mostly were in Hindi medium, thus no questionnaires were distributed). As the people of the settlement were mostly Hindi speaking[2] and not very fluent in English, so the interviews were conducted in Hindi and the data was translated to English and ticked on the questionnaire. Site visits show that the houses in this settlement are mostly single units, mostly temporary, self-built by the low-income group and the economically weaker section inhabitants.

[2] Hindi is the National Language of India. Out of 32 languages in India 16 are widely spoken all over the country. Combing all the Languages and Dialects the number 3250(approximately)

Background:

Sir Edward Lutyens planned New Delhi in the early twentieth century, which has since been followed by other master plans in 1960, 1990 and 2002(A fact Sheet, Delhi 1999). However over the years despite building and zoning regulations the city has grown irregularly outside the structure of city plan mainly as a result of rise in urban population due to migration of poor people from rural areas for better job opportunities. The urban per capita income is estimated to have grown by 135 per cent as against only 30 per cent rise in rural income thus leading to massive city growth, which represents the transference of rural poverty to an urban environment. 67% of rural households have less than Rupees 12,000 (less than £120) of annual income per household and 92% have less than Rupees 25,000 (less than £250) per year, the corresponding figures for urban areas are 37% and 72% respectively reflecting the economic stagnation of rural areas and comparatively better position of the urban squatters (HUDCO, 1999). Migrant's account for 50% of the population increase in Delhi every year: 40% migrate due to family ties, 35% for employment, 22% for other reasons and 3% for education (A Fact Sheet, Delhi 1999). Post-independence refugees came to Delhi from the then West Pakistan and for many years now illegal immigrants from Bangladesh have been settling in this city adding to the urban shelter crises (www.unchs.org).

As mentioned due to the acute shortage of land, shelter and infrastructure in rural areas, many new migrants from rural areas encroach public land to put shackles in squatter settlements. Delhi, to a newcomer is a city where it is almost impossible to buy land, acquire house or rent a house (Buch N.M, 1991). Rural migrants have few options and millions of people have made their homes in unauthorised settlements in conditions probably worse than their rural homes. Despite these poor conditions, the slum population of India is growing continuously. These shackles have been recorded to grow from 12749 in 1951 to over 4,80,000 in 1994. Squatter settlements have grown from 929 in 1990 to 1080 in 1994 and projected to reach 45 lakhs by 2011 A.D (A Fact Sheet, Delhi, 1999). Squatter settlements are common to all cities in India and many other parts of the developing world- a result of unavailability of land and shelter at affordable costs. And any piece of open land regardless of suitability for construction is liable to squatting the houses are built of mud and plastic sheets, of bricks and cement. The streets and alleys are often no more than seven feet (two metres) wide and also serve as open sewers.

These settlements mostly develop near industrial or residential areas so that people can find easy employment nearby. Hence informal housing and workplaces develop all over the city, which are physically entwined with the urban economy and Bhumeeheen camp is one such settlement. These residential areas are not recognised by the corporation authorities so they do not have basic infrastructure facilities and 50% percent of the population is not covered by sewerage facilities (HUDCO, 1999). There are wide disparities in the distribution of public resources, utilities, social services and facilities in these squatter settlements expressing a need for change in planning and prioritising. In the year 1956-57 in order to deal with the growing backlogs in urban services and the further growth of slums the Central Slum Improvement Act, 1956 was enacted and first applied to Delhi and slum removal was discouraged (www.unchs.org). This is evident in the target priorities set by government for the year 1999-2000 which are stated below.

Targets of the Government 1999-2000:

- Nations commitment to eradicate poverty
- Reduction of income disparity and socio-economic inequalities
- Provide basic amenities including housing for improving the quality the life of the poor for other weaker sections of society
- To improve the living condition of the urban and rural areas
- As land is a scarce resource, national policies are directing towards incentives for growth of small and medium towns. Metropolitan and city regional plans aim at high density low-rise in an effort to minimise the spread of urban peripheries and integrate
- Land use- cum-transport-cum-services structures that give lowest priority to personalised vehicles and low density.

Inner city redevelopment is addressed to compatible land use and new uses for old structures. During the year 1999-2000, 21,48,000 slum dwellings have been covered under

this scheme, against an annual target of 47,66,000 and is shown in the figure 5.40 below.

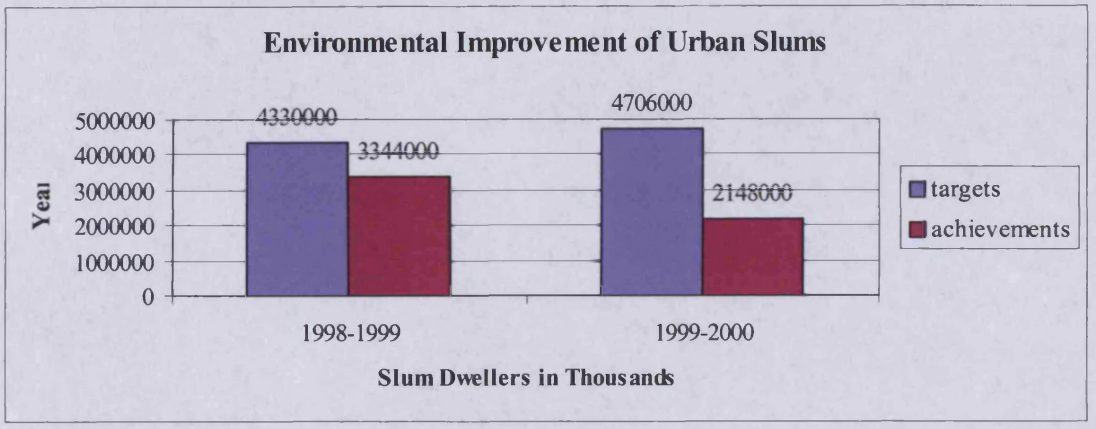


Figure 5.40 (Source: Annual Report, 1999-2000, Government of India)

The urban housing and urban poverty alleviation for the 10th Five Year Plan includes urban transport, urban housing and urban poverty with special focus on slums. Along with shelter present policy of the government lays emphasis on the environmental improvement of the urban slums rather than removing them and focus on slums, urban development, urban water supply and sanitation which includes low cost sanitation, sewerage and solid waste management and urban environment (Annual Report, 2000-01). Wherever a sense of permanency has been imparted and basic services are provided, the settlement has grown into a more prosperous community. The quote below by Mahatma Gandhi best describes this.

> *"The poor of the world cannot be helped by mass production, only by production of the masses"*
>
> *Mahatma Gandhi*

A very good example of this is the work done by " The Slum Networking Program" in the slum area around the rivers Khan and Saraswati in the city of Indore. This project was named " The Indore Habitat Project". Their concept works around improving the slum by starting with the infrastructure. The other alternative to the self-built house of the urban poor is mass public housing; the end result of most such developments is repetitious, look-alike structures.

5.6.2 Location:

Figure 5.41

Bhumeeheen Camp is located in the southern part of Delhi in Kalkaji Extension and shown in the figure 5.41. The main approach road to this area is Guru Ravidass Marg. It is a small settlement compared to other squatter settlements in the area owned by the public sector and having around 2000 households. Kalkaji Extension has three squatter (considered illegal by authorities) settlements: Navjeevan Camp, the largest settlement in the area, Nehru Camp and Bhumeeheen Camp. Kalkaji Extension also has DDA flats, planned houses and other cooperative group housing flats whose residents employ the people living in the squatter settlements as domestic helpers. To the north of Bhumeeheen Camp is Navjeevan Camp, open space on the eastern side, which has been designated by the DDA as a park. The Tughlakabad Extension is on the southern side, while the Kalkaji DDA flats are on the western side. Some of the people who migrated to this area were evicted from their pervious squatter units under major slum clearance drives by the government[3] other people came directly from their villages to Bhumeeheen Camp. Initially 10 to 12 families built up their shacks in Bhumeeheen Camp after clearing part of the jungle.

The camp is a clustering of people who mostly belong to the same region, are of the same caste and religion, and speak the same language. This area attracted more people because of the location of Okhla Industrial Area (which came up in the late 1960s and early 1970s).

[3] The Rehabilitation Scheme beginning with the Slum Clearance and Improvement Scheme of 1956 has a cut off date and later settler cannot make use of its provision. The Rehabilitation Scheme offers three options, if the land owning agency agrees to forfeit the land, the slums can be allowed to remain where they are and basic amenities provided to them. But if it wants the land back the government will resettle the squatters allowing each family 18sq metres of land, provided the agency gives rupees 29,000 rebuilding each house, the state pays 10,000 and the squatter has to raise rupees 5,000. Another option is if the agency parts with the

Men and women from this settlement found work in the factories as manual labour, or in nearby residential areas as domestic help. Initial settlers occupied free land but those who came in later had to buy land from early occupiers. The early settlers occupied land for their house on the basis of the jungle area they could clear and the amount of money they had for building a structure, but at a later stage the main factor was the availability of land (site observation and interview inputs).

Site Plan:

Bhumeeheen Camp covers an area of about 8.96 acres (about 3.63 hectares) (Slum and JJ Department handout) and is located in the F-division on Delhi Development Authority land (Delhi land-use plan, Delhi Master Plan-2001). The land occupied by Bhumeeheen Camp settlement was planned as one of the major green spaces in the Delhi Zone Plan. This site is easily accessible, lying along a main road. Figure 5.42 given below show the squatter, which has developed along the main street, and is also the main access to the camp.

Figure 5.42

This area is a mixed land use settlement, where most people live as well as earn their daily bread by working from their homes or use their single room homes as shops/stalls during the day and as sleeping quarters at night. Most of the houses are constructed randomly sharing three common walls with other houses along narrow alleys as can be seen in figure 5.43 in the following page.

portion of the land the squatter can be relocated in multi-storeyed structures funded by the agency and the state.

Figure 5.43

5.6.3 Procedure:

Site visits surveys to Bhumeeheen camp were conducted and data collected from interviews conducted of 25 residents using set B questions (refer to appendix 3) and the set B interview questions as well (refer to appendix 4). Along with the observations made, photographs taken during the site visit surveys and secondary data collected have been used to support this study.

Initial site visits were made around the fringes of the settlement along the main road in order to make initial contact and make general conversation with people owning shops mainly the womenfolk and young adults of the settlements. Although initial response number of the inhabitants was low, it gradually picked up over the proceeding weeks and people opened up to general conversation which were noted and the questionnaire surveys were conducted during the later stages of the site visits. People participated more enthusiastically in-group discussions concerning their day-to-day problems in the settlement and their comments relevant to this study were noted. Site visits were mainly undertaken during evenings in order to interview a more mixed gender as most of the men of the settlement worked during the day. An interview was also conducted of the representative member of the camp who has been extremely helpful in organising a tour of the camp settlement, which included a visit to the sample houses designed as a model for the people of this settlement to follow and build. According to the representative member, three sample houses were built by the DDA called the "Katha Kazana"; these however were later aborted. According to him the failure of the project was due to the lack of funds and the non-functional nature of the plan. These samples are now being used as a school for children and a training centre for the women in the locality.

5.6.4 Analysis: In this section the impacts of social, economic, environmental, political and technological aspects on this EWS/LIG shelter development will be investigated by testing the hypotheses developed and accessing the user needs from shelter. Question survey data, interview survey data and site observation data has been used for the purpose of this study. Once all the data was collected, it was number coded and converted in to percentage and presented in tables and graphs. Open-ended questions were post coded and analysed and had been used to support the questionnaire survey. The photographs taken have been used to illustrate the physical properties of this development, also secondary data collected during the site visits which includes published data and books have been used to back up this study.

House Type

Squatter Units: Houses built can be categorised into three types- *pucca* (permanent), *semi-pucca* (semi-permanent) and *kuccha* (temporary). This development is mainly inhabited by the low-income and economically weaker section of the community and consists of semi permanent houses and temporary units, self-built by the residents using mainly salvaged materials from demolition sites and chor (thief) bazaars in any vacant public land. A single unit is used as a bedroom, kitchen, dining room, living room and washroom. The rooms are very small, a few measured were not more than 20sq metres.

Indigenous self-help units are also evident rural regions of India. Such units therefore often cost lower than usual houses as labour costs and costs of building materials are cut down. However sanitary conditions in these squatter settlements are often poor due to lack of services resulting in poor environments and poor health conditions for the inhabitants. As a result in the past local authorities have often resorted to demolition of squatter settlements leaving the inhabitants shelterless. But according to central slum improvement act of 1956, slum removal is being discouraged and slum improvements are being promoted instead by giving them legal rights to the land illegally occupied and access to basic services (www.unchs.org).

Social Aspects: In this sections user preferences and priorities concerning shelter choices, location, their level of participation and their requirements from shelter will be studied. The analysis will help determine whether the absence or presence of user participation has any

bearing on the successful provision of user requirements, their satisfaction and their quality of life.

Social Hypotheses *There is a relationship between user participation, preference and needs inputs in house planning and user satisfaction*

The residents of this settlement are mostly self employed in the informal sectors or working in factories or as domestic helpers in the MIG and HIG neighbourhoods.

Questionnaire survey data:
Areas Needing Attention

In response to the questionnaire question on what was wrong with the construction of their house from the choices provided respondents said thermal comfort, service provision and space inadequacy. Their responses are as shown in the figure 5.44.

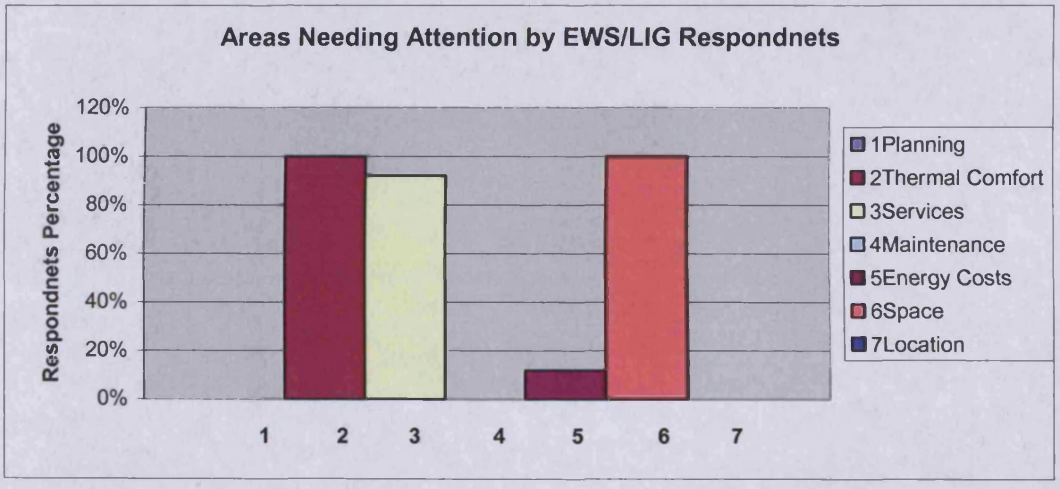


Figure 5.44

Incorporation of user needs in their units

In response to the question on whether the respondents felt that their need and preferences were taken into consideration and incorporated in the planning of the city planning and public houses built for them all the respondents felt that the needs of the their groups were overlooked and the results are shown in figure 5.45 below.

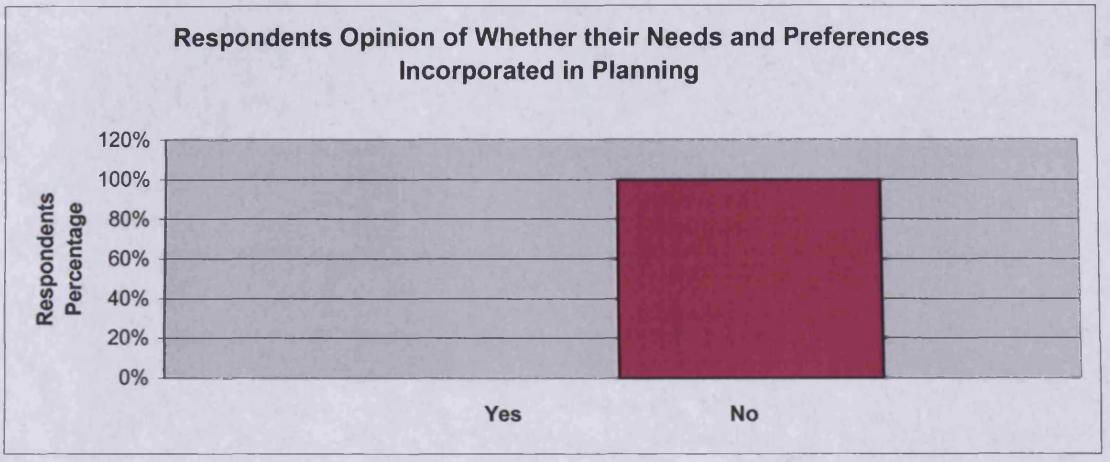


Figure 5.45

The representative member of this settlement strongly felt that the needs of this community were ignored and their living conditions were very poor. Since this settlements is an illegal settlement, service are not adequately provided and according to him the government had plans to relocate them to another settlement in the city fringes. Although the Government has promised to relocate their families to a new site on the fringes, most of the new sites are not adequate for the entire population of this camp. According to one respondent, she and her family were constantly insecure about the house, which could be demolished at any time; they would have to start all over again. According another respondent, her husband and her family of four children live in a one room and one wall which is facing the main road has been demolished the municipality bodies and each time they have built a new wall further in from the road (so their room is now much smaller). They have been given a deadline to move out to by March 2003. The figure 5.46 given in the following page shows one of the houses, which is in the process of being demolished.

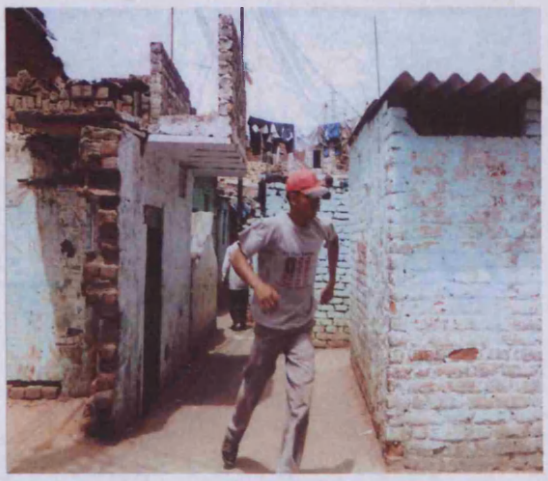


Figure 5.46

According to the respondents a large percentage of the respondents here are employed by the middle-income and the high-income groups in the same locality as domestic help for years, thus the three income groups not only live in the same area but also associate on a day to day bases where one group fulfils the needs of the other. This means that relocation of the squatter settlement would not only take away the jobs but also affect the MIG and HIG dependent on their domestic helpers to do their day-to-day household tasks. The respondents felt that since most resettlement colonies are planned at the city fringes jobs employment opportunities reasonable distance would be difficult especially for the womenfolk. According to these respondents these important aspects are not being considered in the plan to resettle them.

Apart from people working in MIG and HIG households, some of the respondents here are also self-employed in the informal sector (rag-pickers, craftsmen and vendors- who work at home). A larger percentage of which are women because of the social taboos against them working outside the house. One respondent who runs a shop said working from home helped her to contribute to the family income at the same time as they run their households. Another respondent, a graduate who has been living here since 1980, has a watch repairing shop and a phone booth in his house facing the street. According to one respondent having the workplace in the house, cuts down expenses of rent and travelling. For people living here the house acts as a dwelling unit in multiple senses and is also a productive asset- a workplace.

The figures 5.47 and 5.48 given below show some home-based enterprises termed "informal sector", as they are not registered.

Figure 5.47

Figure 5.48

User preferences and priority reasons concerning the choice of a this particular shelter:

In response to the question on priority reasons in shelter consideration from the reasons provided, most respondents choose location advantage and cost of shelter. The results are depicted in the figure 5.49 given in the following page. The squatter settlement is located near MIG and HIG neighbourhoods where some of the respondents work; also this settlement is centrally located with all-important amenities nearby.

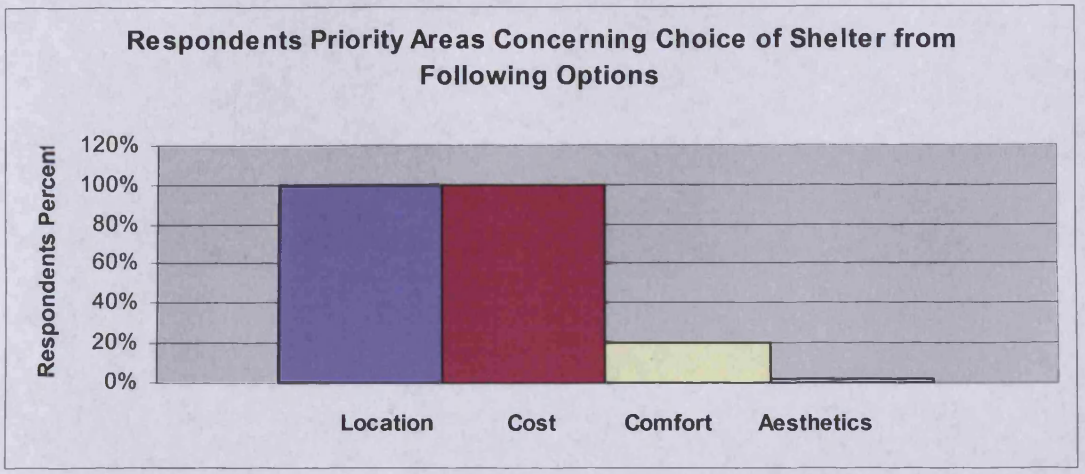


Figure 5.49

In response to the question on what the reasons were for their choice of location for a house from the options given a higher percentage of the respondents said proximity to workplace, friends and family and to facilities like markets, schools and hospitals. The results are shown in the figure 5.50 given below. This squatter settlement situated on a main road and hence has easy access to public transport as well.

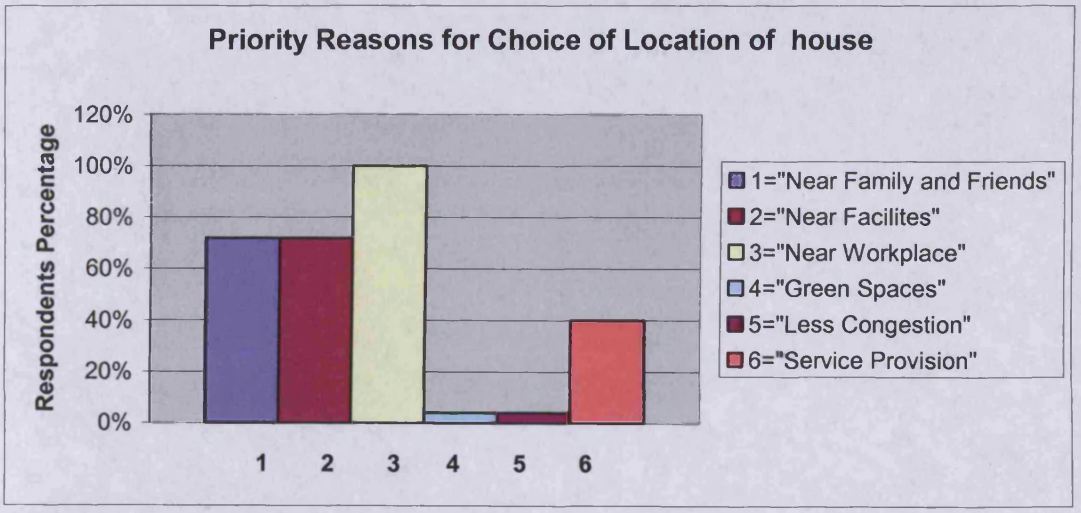


Figure 5.50

According to the representative of Bhumeeheen camp most incoming migrants come and settle in the same areas where there fellow villagers have settled before them, thus most families prefer to live in areas with a sense of familiarity and security.

In response to the question on what important factors they look for in a house from the option given 100% percent rated space, cost effective and low maintenance. The areas with

lower priorities, which were less than 50 %, were communal playgrounds, types of materials used and energy efficiency. Results are shown in figure 5.51 given below.

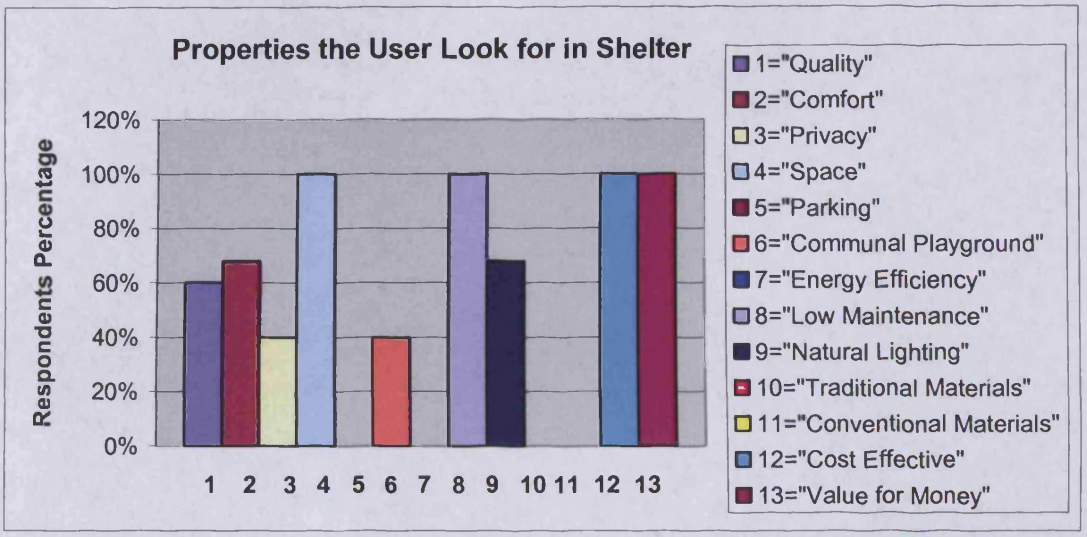


Figure 5.51

The following graphs are intended to show user satisfaction levels and their rating of various aspects concerning general comfort, indoor space, privacy, services and quality. In order to gauge whether priority areas identified by users are satisfactory or not the results in the following graphs will be compared with the results shown in figure 5.51.

Comfort: Figure 5.51 above shows that 68 % of the respondents consider comfort an important aspect in a house. In response to the question on whether they were satisfied with the comfort conditions of their house a larger percentage responded no indicating dissatisfaction. Figure 5.52 shows the response of the respondents.

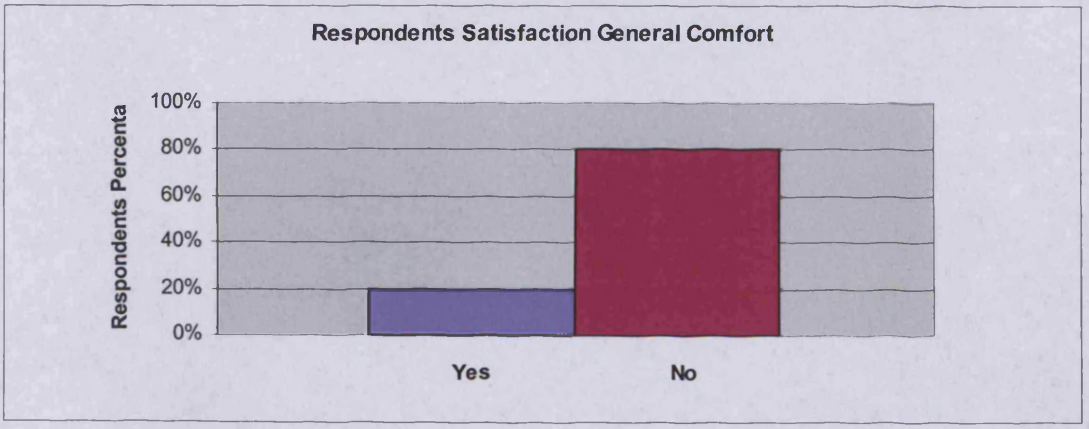


Figure 5.52

Space: A larger percentage also gave importance to space adequacy and in response to whether lack of space was a problem, all respondents yes. The results are given in figure 5.53 given below.

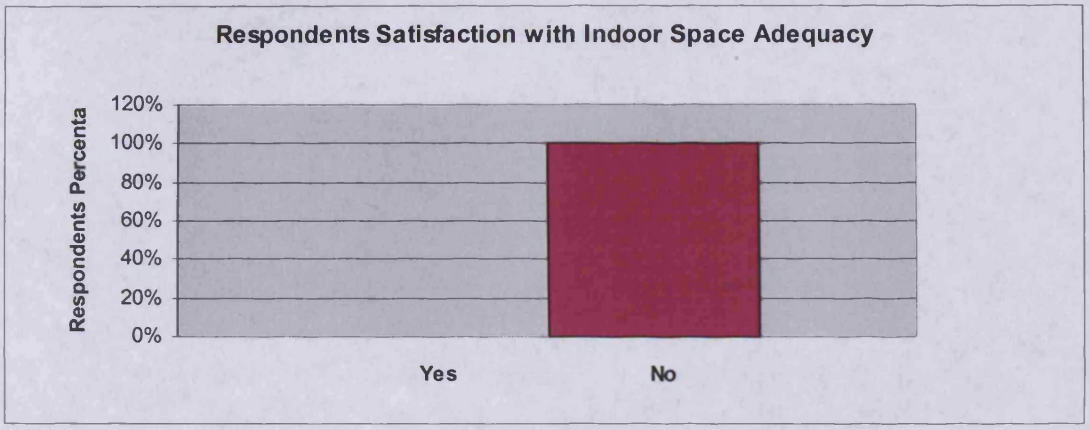


Figure 5.53

Privacy: In response to satisfaction with indoor privacy a larger percentage of the respondents said no however figure 4.51 in the previous page shows that for the respondents of this settlement privacy are not a priority. The results are given in figure 5.54.

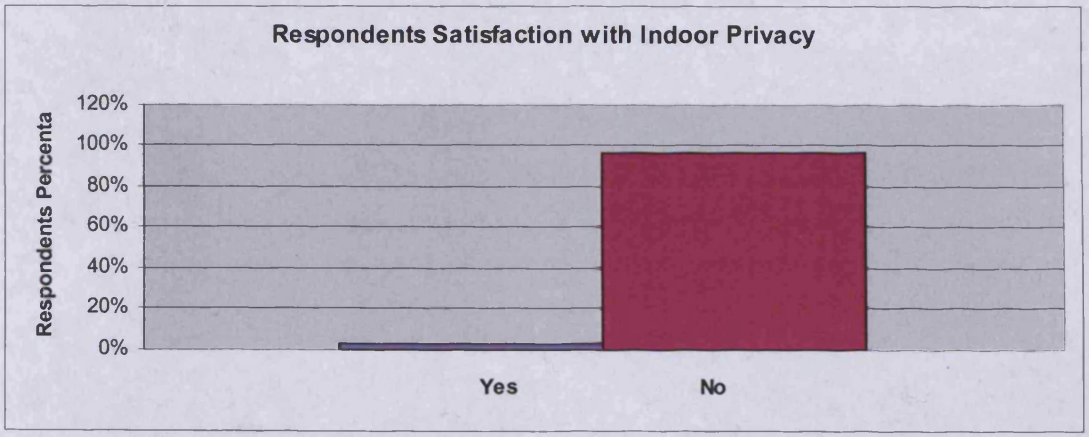


Figure 5.54

From site observations it is evident that most households live in single room units and each household, with not less than five members. Cultural as well as social factors encourage large families, and women have very little say decision making. One of the reasons is the

numbers of bread earners are more in a bigger family and lack of awareness and access to safe birth control facilities.

Services: In response to the question on satisfaction with service provision all the respondents showed dissatisfaction and the results are shown in figure 5.55 given below.

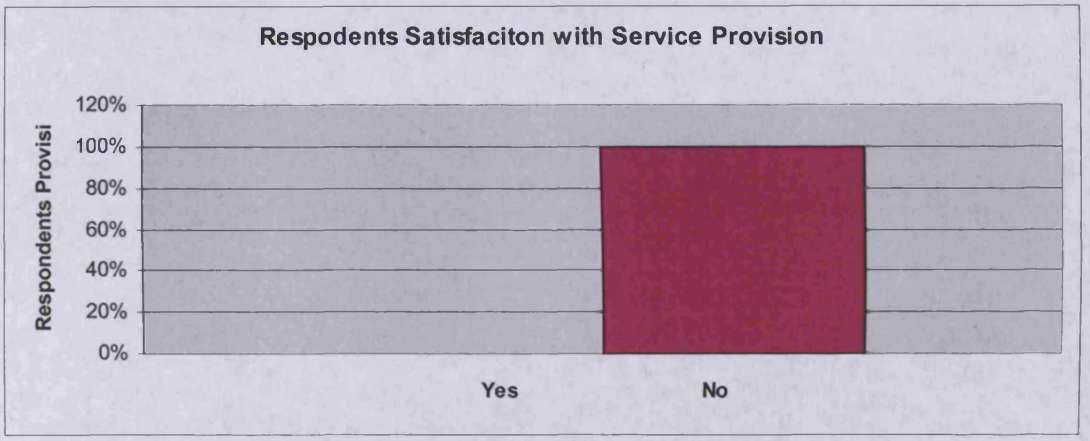


Figure 5.55

Quality: figure 4.51 shows that 60% respondents said that quality of the house was also an important aspect. When asked to rate quality of their units on a scale from very poor to excellent a larger percentage has rated their units as poor quality and some have rated it as moderate. The results are shown in figure 5.56 given below.

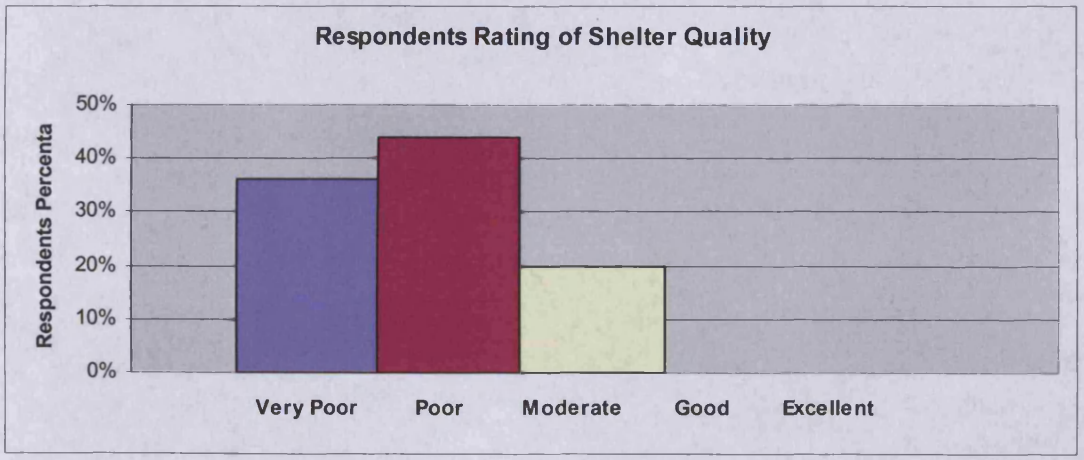


Figure 5.56

The respondents of this squatter settlement have put in minimum investments and mostly live in temporary units, which require no maintenance. However a large number of the respondents living on the fringes commented on the demolition of their units, which resulted in additional costs to repair the broken roof and walls.

The figures given above in this and the previous pages indicate that the shelter priorities of the respondents are dissatisfactory. In additions most respondents felt that their service needs were not incorporated within the planning of the city. This study suggests that despite the users building their own units, the conditions are unsatisfactory due to lack of funding and adequate services and support from public bodies. Therefore only participation is not the answer to shelter and shelter needs of people. Participation needs to be supported by public support in the form of funds, resources and service networks.

Site observation data:

From observation it is evident that this settlement is quite similar to rural settings. The communal taps for instance is similar to the village well, where people gather to collect water and socialise. In terms of shelter space most of the shelter units in this development are very cramped single rooms an example is shown in figure 5.57 below.

Figure 5.57

During the site visits it was evident that the inhabitants spend more time out in the narrow lanes. The lanes thus is a much-used social space as can be seen in figure 5.58 given in the following page, providing about a day-to-day interaction space for the inhabitants and a sense of a strong communal bonding. However the narrow lanes were also being used to dump garbage and human ablutions thrown in the open drains.

Figure 5.58

Most of these lanes are narrow and in some parts the roofs of two houses were extremely close obstructing sunlight penetration into these lanes as can be seen in the figure 5.59 given below. However during summer they also provide shade, which is essential for protection from heat.

Figure 5.59

Economic Aspects: In this section the areas concerning present shelter costs, shelter expenditures, budget impacts, shelter value will be looked at in order to gauge present shelter costs, user expectations with respect to affordability. Also the based on additional data collected a comparison is made between the shelter investment costs and ten years of running energy costs in order to gauge the likely scenario in household investments.

Economic Hypotheses *There is a relationship between affordability factor, present costs of shelter and access to shelter.*

Present costs of shelter: In terms of earning the economically weaker section and the low-income group earn the least and parallels can be drawn with the conditions of the underdeveloped countries of the worlds. Although public bodies have built houses catering to this group, due to a large increasing number most of the households end up homeless and live in temporary squatter houses in settlements like this one. According to HUDCO reports the average incomes of EWS falls below Rupees 2100 (£26 approximately) and LIG households fall below Rupees 5,500 (£68 approximately) (HUDCO, 1998). Since the income of people in the area is generally quite low basic houses are beyond their reach. Based on HUDCO report on their annual earnings for these households to be able to afford a basic unit, they would have to invest more than 20 years of savings. One respondent said he worked as a labourer in the area called Madanpur Khadar, which earned him rupees 60 per day (less than a pound) and his monthly income came to around rupees 1800 (approx £20). Out of this earning he spent rupees 250 every month on electricity bills. He found it very difficult to make ends meet and even educating all his children was not possible. He lives in a one- room unit of 6sq m area in this settlement, which he built using scrap tin, wood and old bricks.

Questionnaire and interview survey data

Value for money: The above discussions indicate that most LIG households are too poor to afford any kind of formal housing by themselves, however since shelter is a basic necessity people have built units even with twigs and plastic sheet roofs in order to get protection from sun and rain. In response to the question on whether their house investment had been a good value for their money most respondents responded yes and the results are shown in figure 5.60 given in the following page.

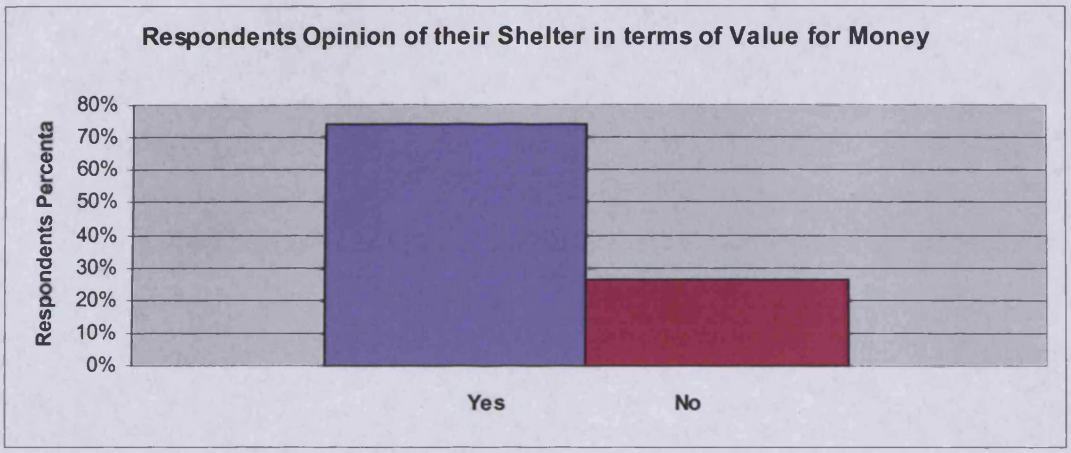


Figure 5.60

Impact of budget: In response to the question on whether the respondents thought that budget affected the planning and the choice of materials used, a larger percentage of the respondents ticked yes and this is shown in figure 5.61. This indicates that in this housing development as well most people think that the budget has a lot of bearing over the planning and choice of materials. This is their general impression since at present most conventional product prices are high and rising continuously due to inflation, therefore a low budget meant compromises. However most people are not aware of the effective use and management of the options of re-use, recycling and cost-effective materials and technologies, which can provide the same results.

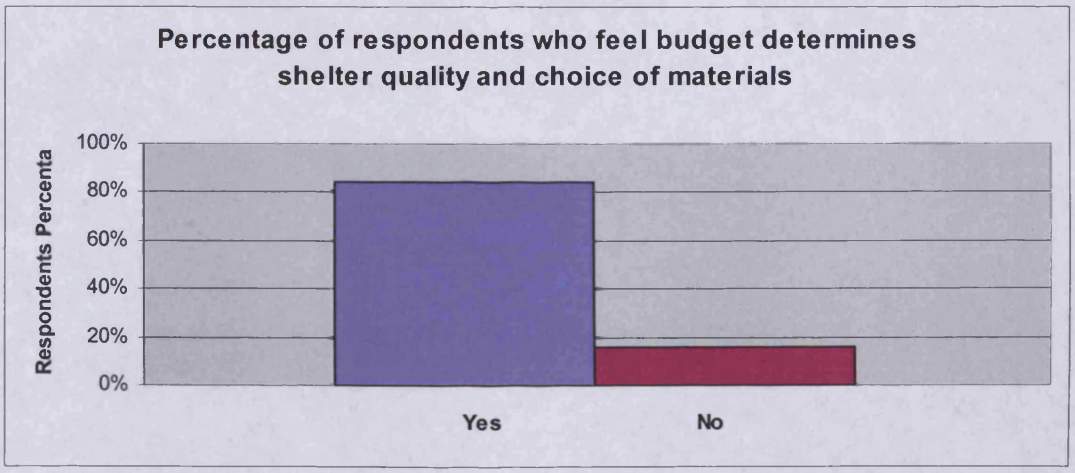


Figure 5.61

Proportion of investment put into their house: In response to the question enquiring how much they spent on their house from the options provided, all respondents said less then 10% of their income and is shown in figure 5.62 given below.

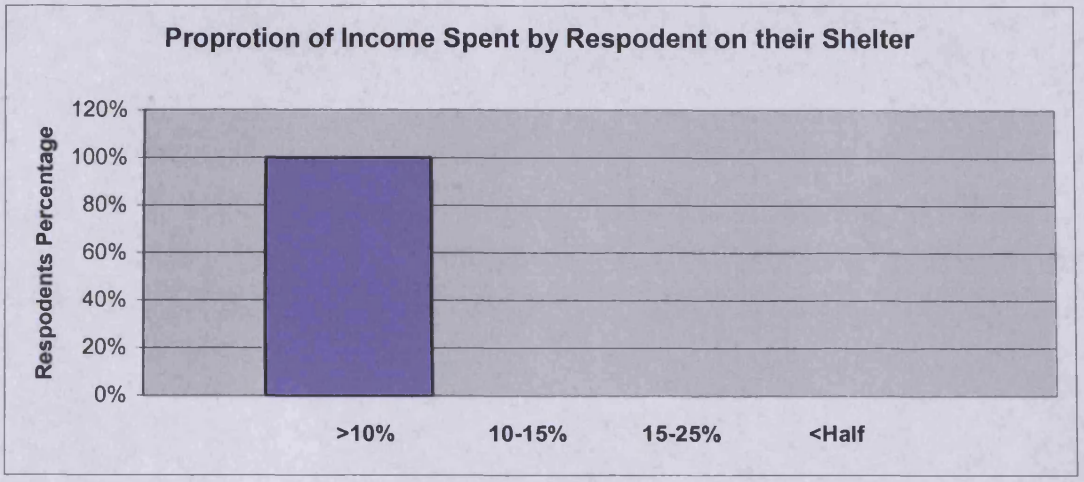


Figure 5.62

In response to the question what they spent their income mainly on maintenance or electricity, a larger percentage of the respondents ticked maintenance but mainly commented on other needs such as food. Some of the respondents said they got electricity for free by cutting into the main electricity line, while others said they paid an average of Rupees 125 per month. According to the some respondents, they were also allowed to use one bulb and one fan without paying anything. The results are shown in figure 5.63.

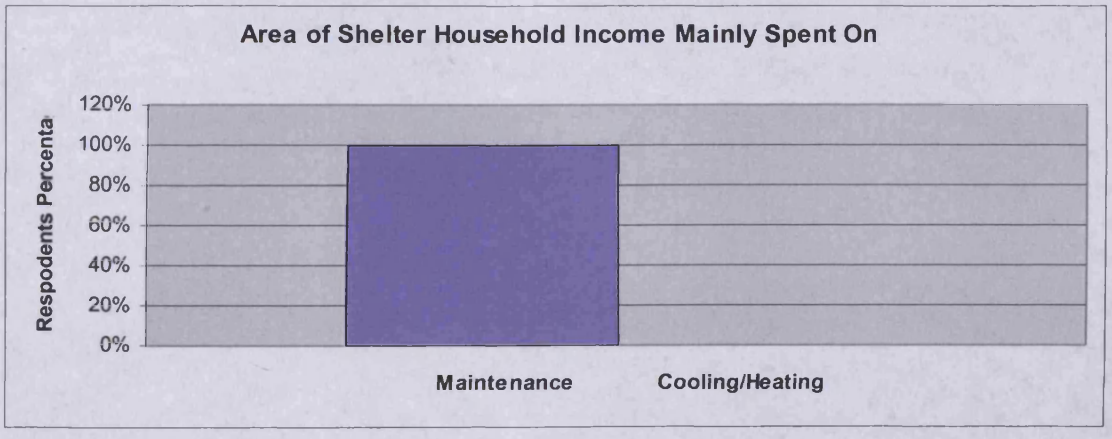


Figure 5.63

Shelter Investment Cost Versus Ten Years of Running Energy Costs

These squatter houses are mostly self-built due to the lack of funds and because the materials used practically cost nothing these units are as close as we can get to a minimum-cost shelter. According to respondents most of the early settlers inhabited their plot free of cost but the later settler had to pay some money to the middlemen. In order find out which area is a households higher invest whether shelter or running the shelter, a comparison is made between likely LIG/EWS investment on shelter and ten years running energy costs. For this purpose the short-term costs, which are initial investment and long-term running energy costs have been compared and data from questionnaire and interview responses have been used. Since most of the households use brick for the structure, the cost of one old brick is taken as rupees 2 (approx based on respondents information) and using 500 bricks per cubic metre, cost of cement rupees 165 per bag, plus other miscellaneous, the likely approximately cost comes to a minimum of rupees 15,000 (£214 approximately). The cost of electricity is calculated taking into account the average spent on electricity by 25 households in the locality and is taken as rupees 1500 per year (£ 21.40 approximately) and ten years of running energy costs therefore taken as Rupees 15000. However in this case energy consumption is solely for the purpose of lighting, entertainment and cooking and cooling/heating purposes is minimal or absent. The comparison between the two is shown in the figure 5.64 given below. This graph shows that the most likely the cost of construction would be equal to the cost of 10 years of household energy consumption (in this case as discussed energy not used for air-conditioning).

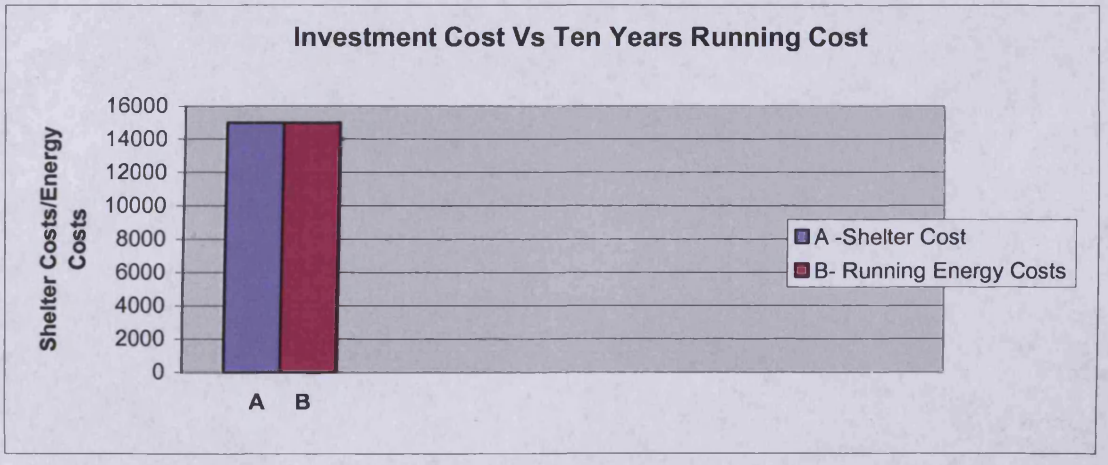


Figure 5.64

Site observation data:

Site observations show that mobile economic activities are common in this area since they are mainly on wheels and have no fixed place of operation. These carts can be seen in the figure 5.65. The goods are mostly food items like fruits, vegetables and items like women's jewellery and are generally carried around on handcarts, cycles or baskets on the head. About 24% of the households surveyed worked in the informal sector having home based enterprises. Therefore of the Government goes ahead with its plans of relocation then the prospects of job opportunities for skilled and unskilled labour will also have to be considered around the new site.

Figure 5.65

This study indicated that most inhabitants of this sector cannot afford formal shelter units developed by the public and private bodies and hence end up in squatter settlements where in most cases land acquired is illegal and there free and materials used cost nothing or minimum. Most units were self made and materials used recycled materials acquired from scrap dealers and demolition sites. Some of the materials used in this settlement are not even construction materials like old plastic sheets, tins cans and cardboard paper.

Environmental Aspects: this section will look at respondents thermal comfort ratings during summer and winter, type of cooling systems adopted in order to gauge comfort and indoor thermal conditions and level of dependence on mechanical cooling. (According to data collected in literature review and personal observations in stage A case studies, most LIG households use mechanical cooling mainly fans hence this study only looks at cooling

systems used). Although in this settlement the households were less dependent on mechanical systems due to unaffordability. The question on respondent's willingness to reduce dependence and use of mechanical systems if conditions improved through alternative ways was put into the questionnaire in order to gauge respondent's mindset and willingness to adapt.

Environmental Hypotheses *There is a relationship between thermal comfort, energy use and shelter.*

Questionnaire and interview survey data

User rating of general indoor comfort: In response to question on how the respondents rate general indoor comfort on a scale of 1 to 5 where one is very poor and 5 is excellent a larger percentage rated it as poor and is shown in the figure 5.66 given below. According some respondents main discomfort was due to high density living (area per person- 3.2 metres square approximately) the residents also experienced discomfort due to indoor heat and insufficient services. At present only 50% of the population of Delhi is covered by sewage facilities (HUDCO, 1999), and the sewage system is nonexistent in all resettlement colonies and this squatter settlement as the municipal body of Delhi has developed no proper infrastructure facilities.

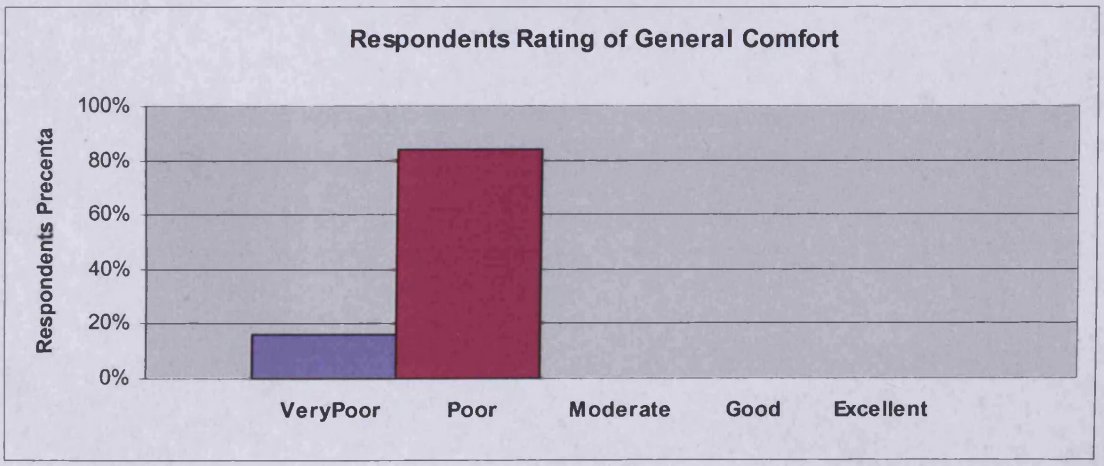


Figure 5.66

In response to the question on rating overheating in summer was a problem on a rate of 1 to 5 where 1 represents never and 5 represents very often, all the respondents said often and is shown in the figure 5.67 in the following page. In addition many respondents added that in

summer the days as well as the nights were not very comfortable. Another reason for discomfort could be that the units are small and high density, also occupants contribute substantial amount to indoor heat due to activities like cooking and entertaining all carried out in the same space.

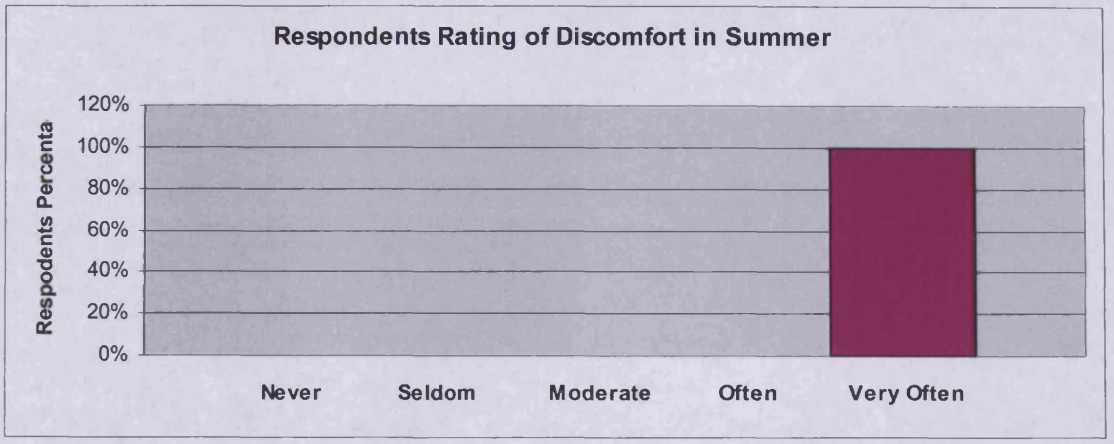


Figure 5.67

In response to the question on what type of cooling systems the respondents adopted, their response was ceiling or table fans, the respondents said they could not afford to invest in air-conditioners. Some respondents said they sprinkle water on the floor, which evaporated and kept the room cool, most of the male respondents said they sleep on the terraces. The results of the analysis are shown in figure 5.68 given below.

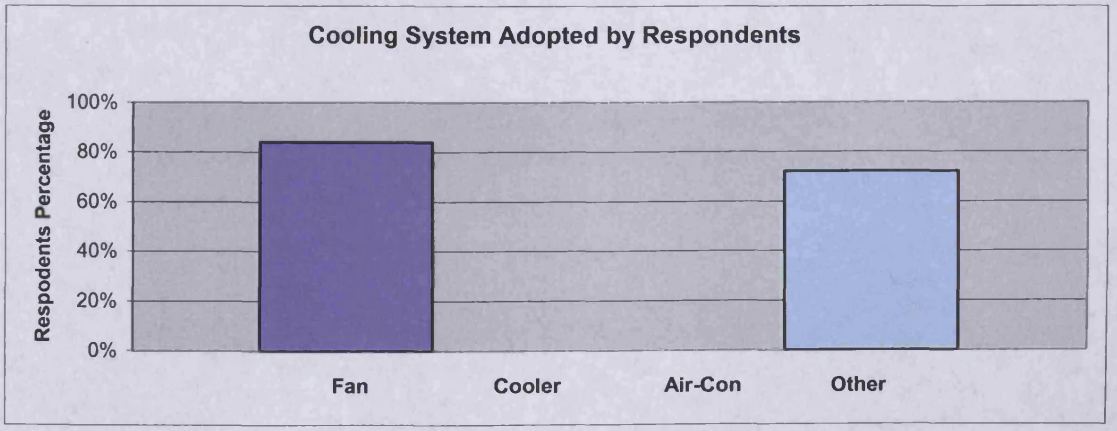


Figure 5.68

In response to the question on rating overcooling in winter on a scale of 1 to 5, where 1 is for never and 5 for very often, the respondents mostly rated it as sometimes and often and is

shown in the figure 5.69. In addition some of the female respondents added they could wear more clothes in winter, in summer they could not wear less due to socio-cultural reasons. From observation it is evident that these units do not have electrical heating systems but the some of the respondents said they have portable coal burning carriers.

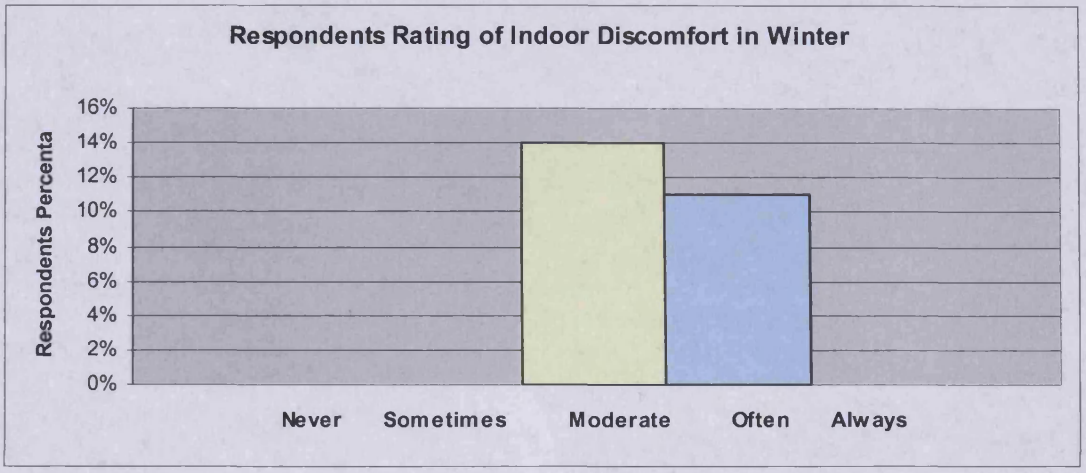


Figure 5.69

In response to the question on whether if indoor temperature was to be improved through planning, maximum use of ventilation and climatically suitable materials would they reduce dependency on mechanical systems even if they could afford it, most the residents answered yes and are shown in figure 5.70 given below.

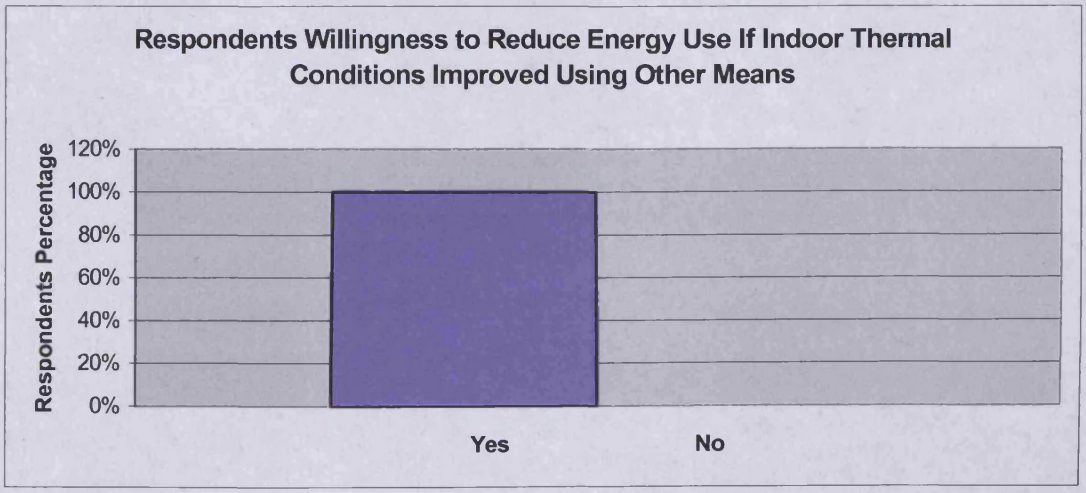


Figure 5.70

Site observation:

Site observations shows that the units have small or no windows and back and sidewalls are shared with the next house as shown in figure 5.71 and 5.72 below given below and hence natural ventilation and air circulation is unlikely.

Figure 5.71

Figure 5.72

Services: From observations during site visits it is evident that the quality of shelter is poor and even the basic services such as water supply and sanitation are inadequate.

Site observation indicate that community water taps at intervals are provided by the corporation authorities but according to few respondents are not sufficient for the residents and there is always a long queue for water near the taps which are located at a distance from some houses. Figure 5.73 in the following page shows one of the community taps in the settlement. Hence some of the respondents have jointly laid pipes with other households in order to draw out water from the corporation lines, not pay for the water they use. Site observations show that households in this area do not have toilets in their houses and they

use the community toilets (Sulabh- about 200 toilets) for which they have to pay. But according to some of the respondents the number is not sufficient for the people living here so there is always a long queue as well.

Figure 5.73

Based on the data collected the lifestyle of EWS/LIG household has been depicted in the figure 5.74 given below based on the questionnaire survey:

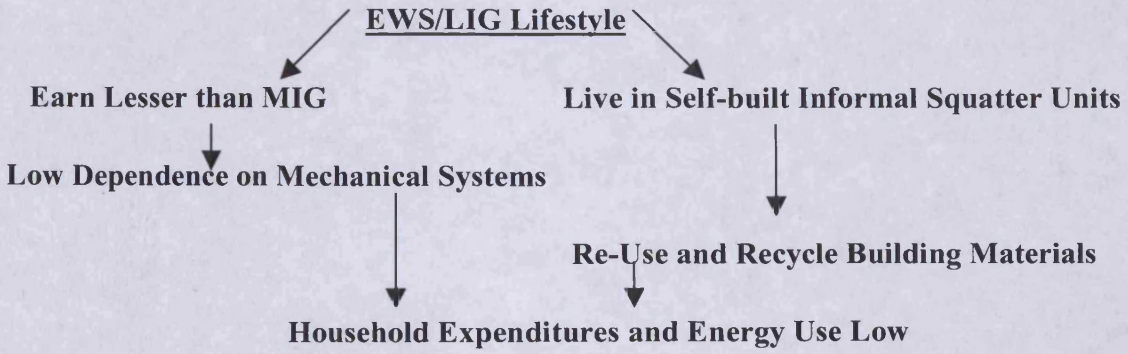


Figure 5.74

In this settlement most respondents have rated comfort as poor and a large percentage of the respondents complained of problems of lack of space, poor infrastructure services and poor thermal comfort in summer and winter. Hence in this settlement there is no relationship between thermal comfort and shelter.

Technological Aspects: In this section the materials adopted, their properties and user preferences and satisfaction levels with the materials used will be looked at.

- **Technological Hypotheses** *There is a relationship between conventional building materials, appropriate building material technologies and shelter.*

Questionnaire survey data

According to the survey participants the building materials used by this category mostly were re-used from demolition sites and from second hand markets, one reason for this is that most conventional materials in the market is not affordable to the residents here. According to some respondents another reason is the insecurity of tenement due to relocation and thus the households do not invest in their temporary shelter units.

The questionnaire response to satisfaction with materials used suggests that a larger percentage were dissatisfied with the building materials, which they felt were less durable and secure. The results are shown in figure 5.75 given below.

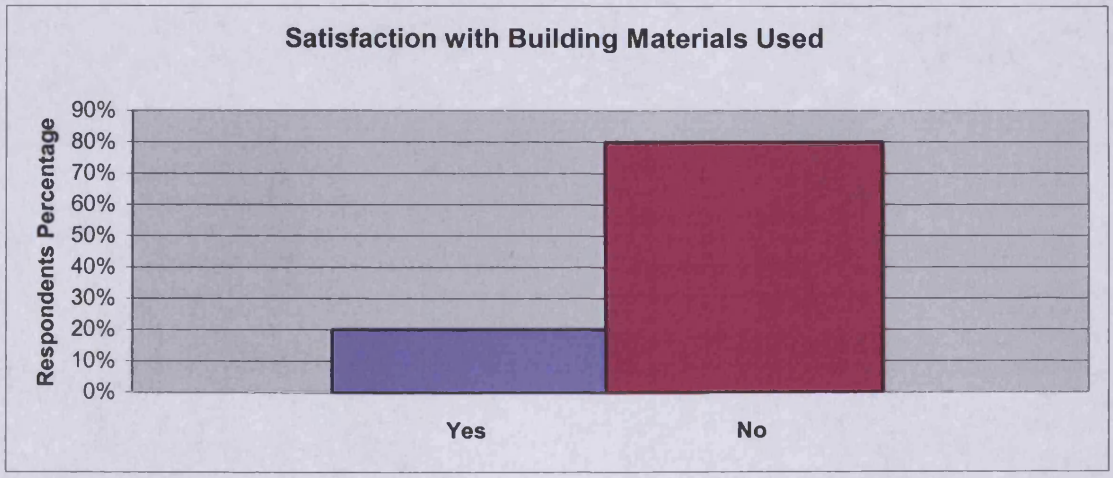


Figure 5.75

Site survey data

Site observations show that most of the EWS/LIG shelter units are clustered together sharing common walls and built of materials mainly brick exposed of plastered white with tiles (asbestos, concrete, country earth). Some of the houses can be seen in figure 5.76 and 5.77 in the following page. Some of the houses also use salvaged junk like timber, beaten tin cans and coal tar drums, jute bags and mud. From site observations it is evident that most units are temporary and very modestly built. In view of the fact that as mentioned earlier most respondents couldn't afford more and also some didn't want to invest into temporary units with insecurity of land tenement.

Figure 5.76

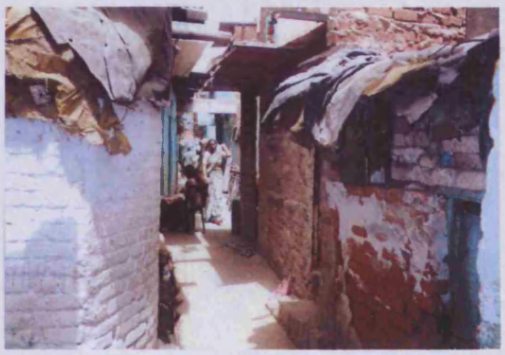


Figure 5.77

Recycling: Since most of the materials used in the settlement were old materials re-used from other sites, embodied energy of the house is likely to be relatively lower than most conventional urban houses. Virgin materials are likely to have more embodied energy as compared to recycled materials. Thus shelter choices made by this group although by default are more sustainable than the MIG households. Also smaller volumes require less energy for basic construction. But if these units are demolished and inhabitants relocated at some point rebuilding the house would mean buying and finding affordable materials from the new locality or transporting the materials from the old house for reuse. Because of relocation the embodied energy would most probably also rise. Around 2000 houses in the camp would need to be broken down and relocated and most of the old building materials would no longer be fit for re-use and left at the site and finally be dumped in landfills. Hence resulting in a lot of wastage as well.

In the area of alternative and appropriate technologies as already discussed, there are many alternative technologies developed but these technologies are not affordable and accessible to this sector. In this case study the respondents have not used the alternative technology

and materials developed due to reasons such as lack of awareness, accessibility and affordability and lack of supportive policies and legislation which provides access to affordable shelter. But despite drawback most of the inhabitants of this settlement have managed a basic unit within their resource capacity. This means that whether the state provides housing support or not, people will help themselves. In this development there is no relationship between alternative materials and technology researched and developed and its application in housing for this sector.

5.6.5 Summary:

For this income group affordability is the most important criteria dictating choice and access to shelter type, which is mostly confined to squatters. Most of these settlements develop around areas with job opportunities formal and informal. Hence squatters develop around vacant areas near industries and middle and the high-income group residential areas where men and women find work as factory workers and as domestic helpers. The units are high density and all the household activities are performed in the same space sometimes including home based industries. It is evident from this study that to the respondents of this settlement shelter holds a very different meaning it is a metamorphosing space; activities like sleeping, eating, bathing and even work all fit into one room at different hours of the day. The respondents of this settlement were not satisfied with the condition of their homes in terms of general comfort. The units of this settlement are not thermally comfortable and as mentioned air-conditioners are not really affordable to this group in terms of the cost of product as well as the energy required running them. Therefore these households lead low energy lifestyles.

Re-use and recycling of building and other domestic and construction waste materials which would otherwise have ended up in landfill sites is evident among this group. Also the members of this sector collect and re-cycle a number of household waste into other useful options and hence contributing to sustainable development. The self-built shelter units are generally made of re-used and recycled materials and therefore will have low embodied energy content. This camp has more than ten thousand shelter units; each unit houses a family of four or more members and most of the units have used some form of salvaged materials. One reason for the use of old scrap materials is cost and the other is that these units are temporary built on public property and hence can be demolished any time. In urban areas, despite of land ceiling laws and other interventions to diversify land

ownership, squatter settlement inhabitants have yet to benefit from them. Relocation of these houses is likely to generate a lot of waste due to demolition of the units. Thus relocation is likely to have negative impacts, not only socially but also economically and environmentally.

Despite fund and resource limitations the inhabitants of this settlement have managed a basic units within their resource capacity. This means that whether the state provides housing support or not, people will help themselves. But these developments do need state support in areas such as infrastructure service facilities along with security of tenure. Security of tenure has been given importance to, by all the participating respondents. In this study sense of ownership has been identified as an important barrier to achieving better quality shelter.

5.7 Case Study III –High Income Group Category

5.7.1 Introduction:

Case study III was conducted of HIG shelter units in New Delhi. This study was carried out in the month of June and July 2002. Most HIG developments are detached houses located in central locations. A questionnaire survey (50 number with response of 28) distributed randomly among HIG respondents and has been used for the purpose of this study.

Background:

Most of the HIG houses are located together in the form of colonies, usually within close proximity to local shops and squatter settlements also develop near these areas since low-income group work as domestic helpers in HIG households.

5.7.2 Location:

No particular site was selected for this study, a set of 50 questionnaires were taken and given to a college student friend who took the responsibility of distributing it among his friends who lived in family owned detached bungalows located mainly areas of central Delhi, and a response of 28 numbers were received.

5.7.3 Procedure:

Once collected back, the questionnaires data was put into pre-coded number categories and open-ended question post-coded and analysed. The results have been converted into percentages and presented in the form of graphs and tables.

5.7.4 Analysis: In this section of the study the social, economic, environmental, political and technological aspects of HIG shelter developments will be investigated by testing the hypotheses developed in order to assess user needs from different aspects of shelter.

House Type:

Detached House: Most HIG houses are big houses more that one floor with lawns in front and back of the house and an example is shown in figures 5.78, 5.79 below and 5.80 in the following page. The materials used are mainly brick, concrete, iron, aluminium and wood. For the interiors common materials are marble and granite local and imported generally more expensive and energy intensive. Most of the houses are either passed on through generations or bought based on personal needs and liking.

Figure 5.78

Figure 5.79

Figure 5.80

Social Aspects: In this sections user preferences and priorities concerning shelter choices, location, their level of participation and their requirements from shelter will be studied. The analysis will help determine whether the absence or presence of user participation has any bearing on the successful provision of user requirements, their satisfaction and their quality of life.

Social Hypotheses *There is a relationship between user participation, preference and needs inputs in house planning and user satisfaction*

This group belongs to the smaller percent of the affluent section of the urban community of New Delhi who can afford the high costs and good locations. Most of the residential units as already mentioned are privately owned detached or semi-detached units are low-density and have their own private gardens.

Questionnaire survey data:

Areas Needing Attention: In response to the question on what was wrong with the construction of their house, a larger percentage of the respondents ticked house plan, among other factors shown in the figure 5.81 in the following page.

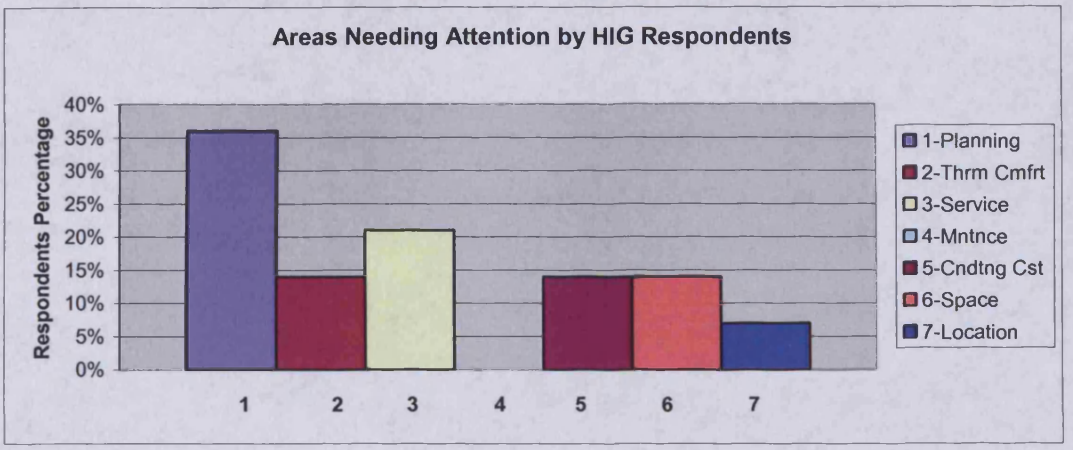


Figure 5.81

Incorporation of user needs in their units: In response to the question on whether the respondents felt that their needs and preferences were taken into consideration and incorporated in the planning and design of their shelter units. 85% HIG respondents responded yes is shown in figure 5.82 below.

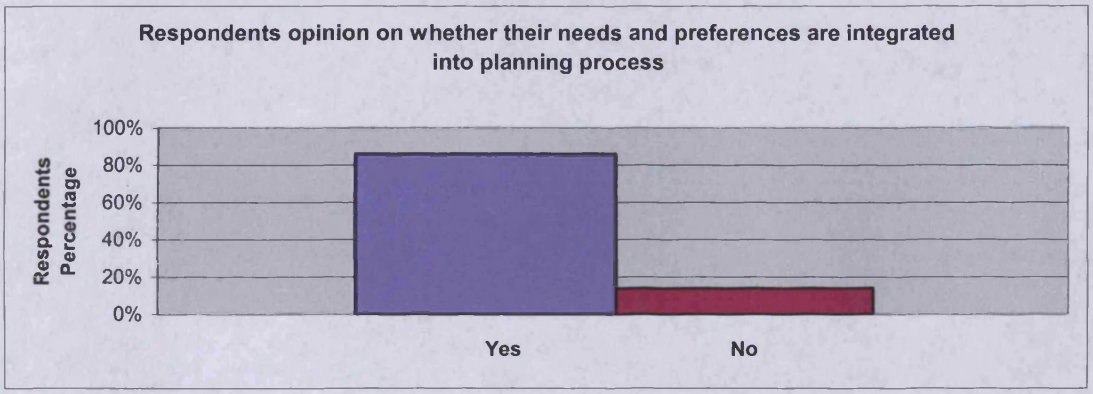


Figure 5.82

User preferences and priority reasons concerning the choice of shelter: In response to the question on priority considerations in shelter choice from the options given most respondents ticked location advantage, as compared to the cost of the unit, comfort or the appearance of the structure. The results are depicted in figure 5.83 in the following page.

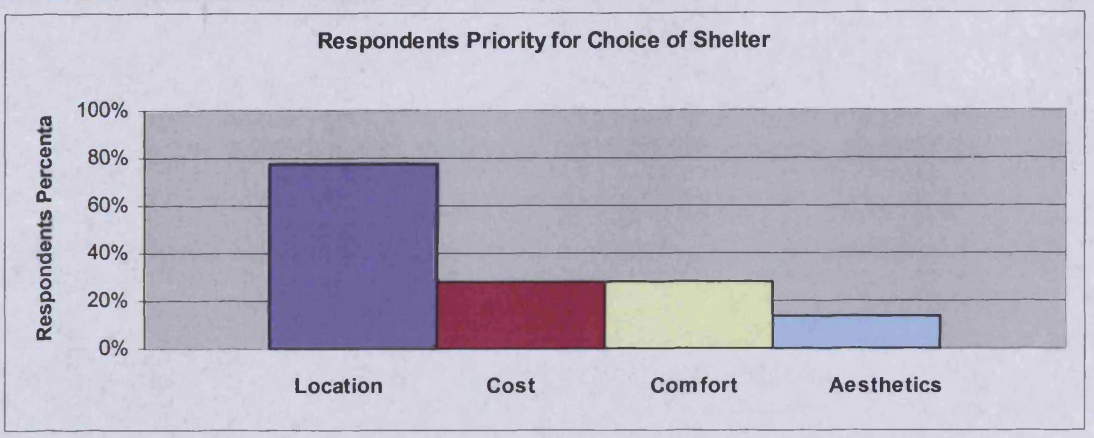


Figure 5.83

In response to the question on what determines the choice of location from the options given most respondents selected facilities, less congestion and accessibility similar to the MIG response to the same question and is shown in figure 5.84 given below.

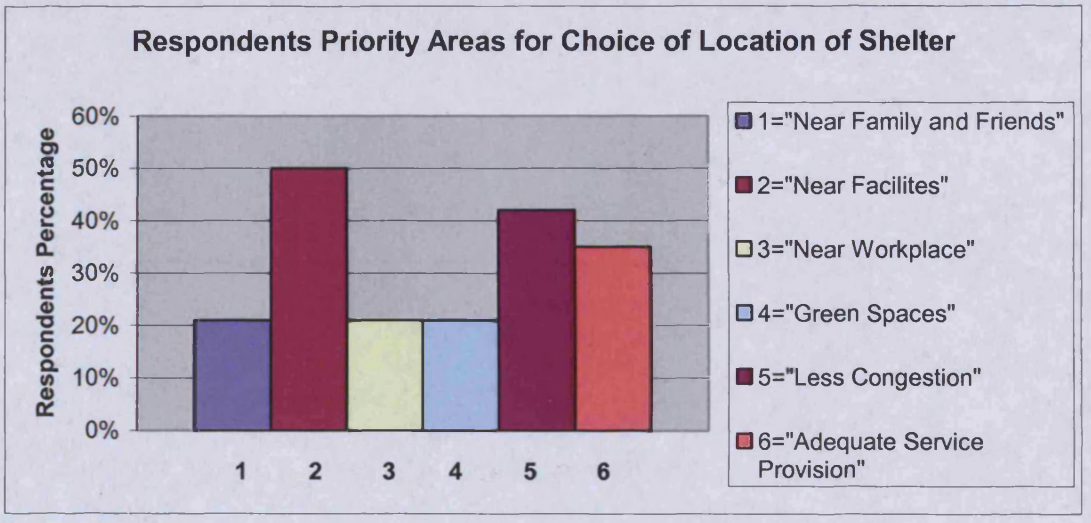


Figure 5.84

In response to the question on important factors they look for in a house from the option given 85% percentage said comfort, 78% said space and 71% said privacy the results are shown in figure 5.85 in the following page.

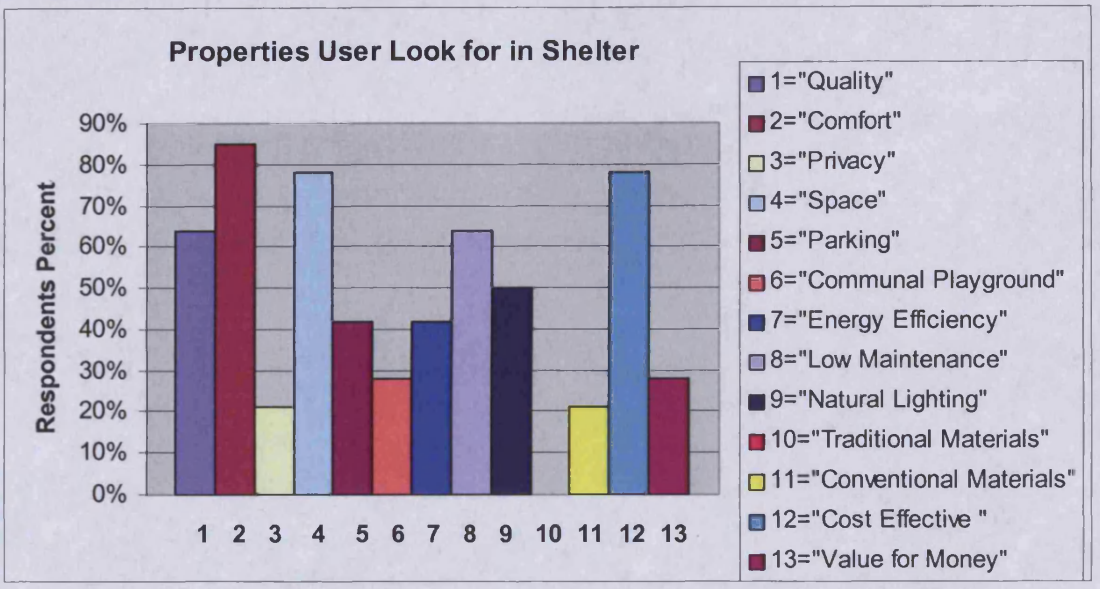


Figure 5.85

The following graphs are intended to show user satisfaction levels and their rating of various aspects concerning general comfort, indoors space, privacy, services and quality. In order to gauge whether priority areas identified by users are satisfactory or not the results in the following graphs will be compared with the results shown in figure 5.85.

Comfort: Figure 5.85 above shows that 85 % of the respondents consider comfort an important aspect in a house. In response to the question on whether they were satisfied with the general comfort conditions of their house a larger percentage responded yes. Figure 5.86 given below shows the response of the respondents.

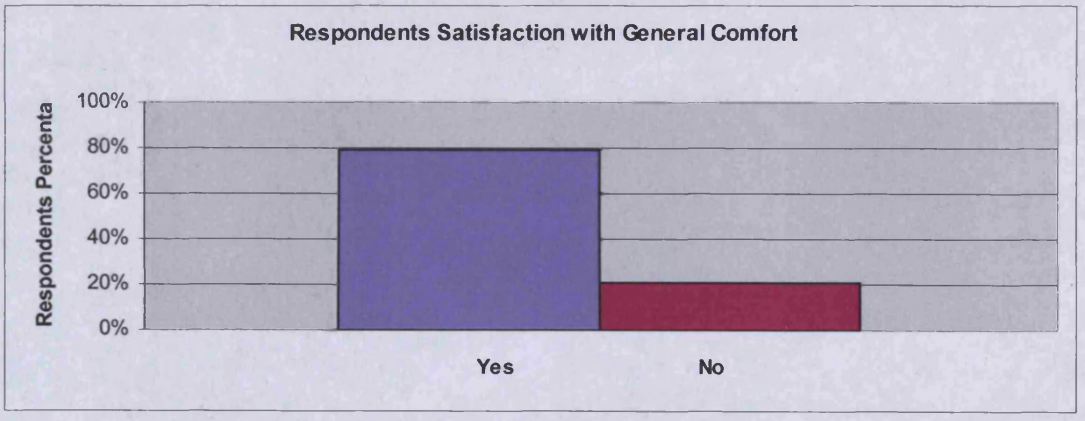


Figure 5.86

Space: Table 5.85 in the previous page shows that large percentages have also given importance to the provision of adequate space and in response to satisfaction with indoor space responded yes. The results are given in figure 5.87 below.

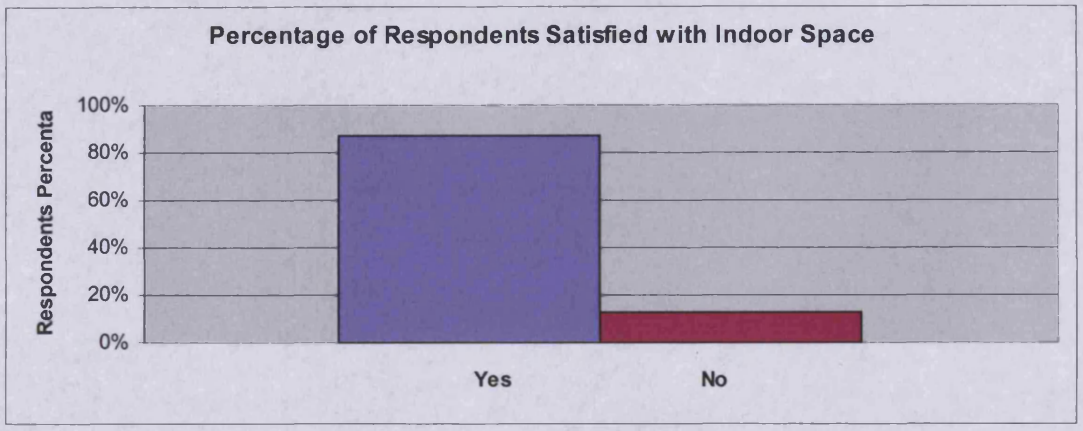


Figure 5.87

Privacy: has also been rated as an important aspect by 71% of the respondents, in response to the question on how they rate privacy in their houses on a scale of 1 to 5 where one is very poor and 5 excellent, a larger percentage have rated indoor privacy in their houses as moderate, good and excellent. The results are shown in figure 5.88 below.

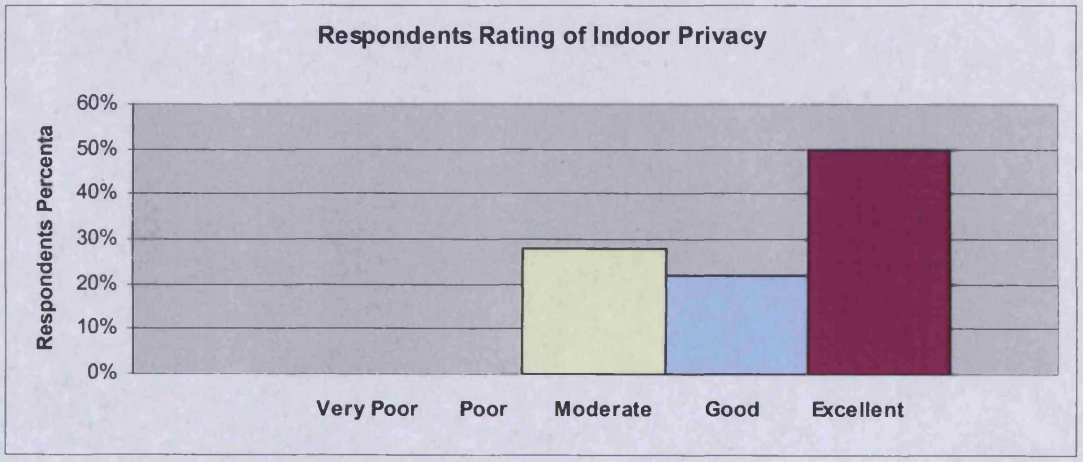


Figure 5.88

Quality: 85% of the respondents looked for quality in a house. In response to the question on rating quality of their house on a scale between very poor to excellent, all respondents rated it between moderate, good and excellent.

The results are shown in figure 5.85 below.

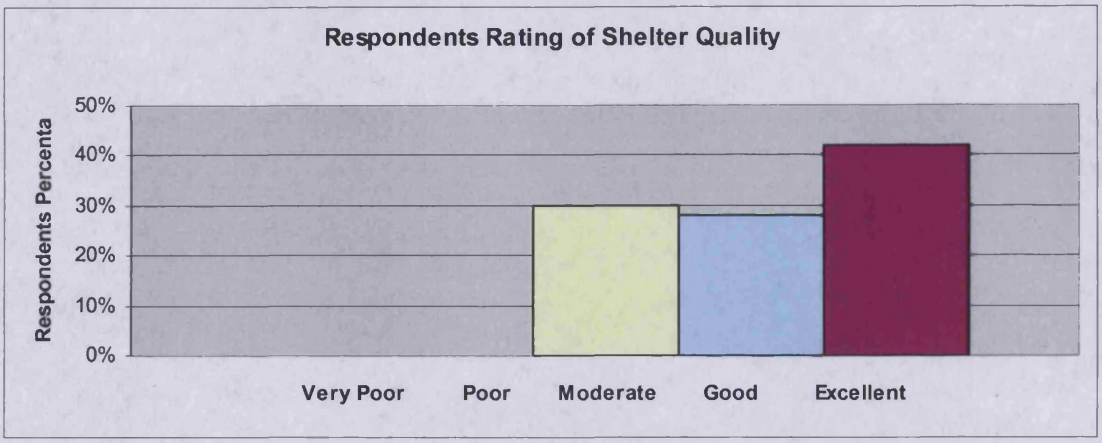


Figure 5.85

Service provision: In response to satisfaction with service provision, most respondents responded yes and is shown in figure 5.86 given below.

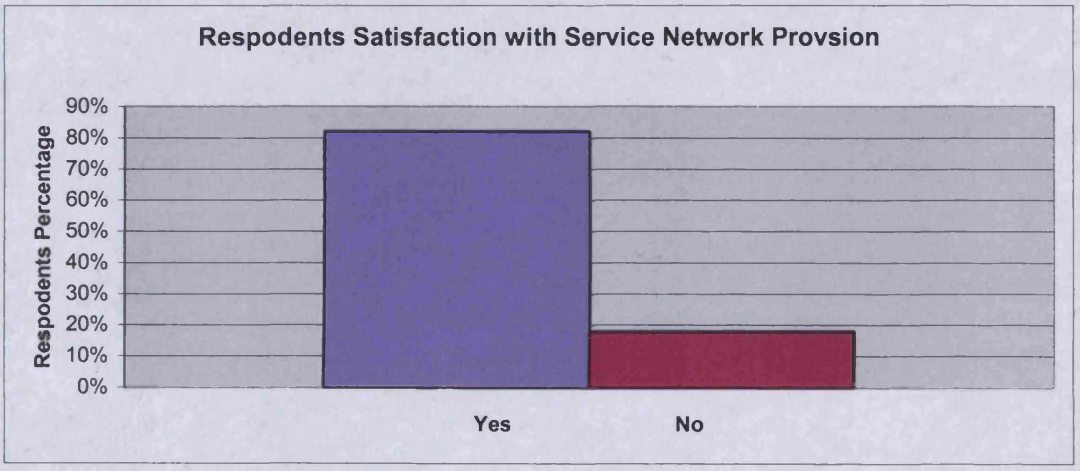


Figure 5.86

The units are built privately built by employing private architects and builders and are usually built according to the needs and requirement of the owner. The responses indicate with respect to most priority aspects in a house, the respondents find satisfactory.

Economic Aspects: In this section the areas concerning present shelter costs, shelter expenditures, budget impacts, shelter value will be looked at in order to gauge present

shelter costs, user expectations with respect to affordability. Also the based on additional data collected a comparison is made between the shelter investment costs and ten years of running energy costs in order to gauge the likely scenario in household investments.

Economic Hypotheses *There is a relationship between affordability factor, present costs of shelter and access to shelter.*

Present shelter costs: HIG households on invest employment of private architects, interior designers and builders, the structure and lavish interiors indicative of the high budget available. HIG lifestyle is also resource and energy intensive with more dependence on mechanical system to achieve indoor comfort. According to a report by HUDCO, HIG households earn more than 10,000 (more than £125) (HUDCO, 1998).

Questionnaire and interview survey data

Value for money: the above discussions indicate that most HIG households invest large amounts into their homes. In response to the question whether their house investment had been a good value for their money, most respondents responded yes and the results are shown figure 5.87.

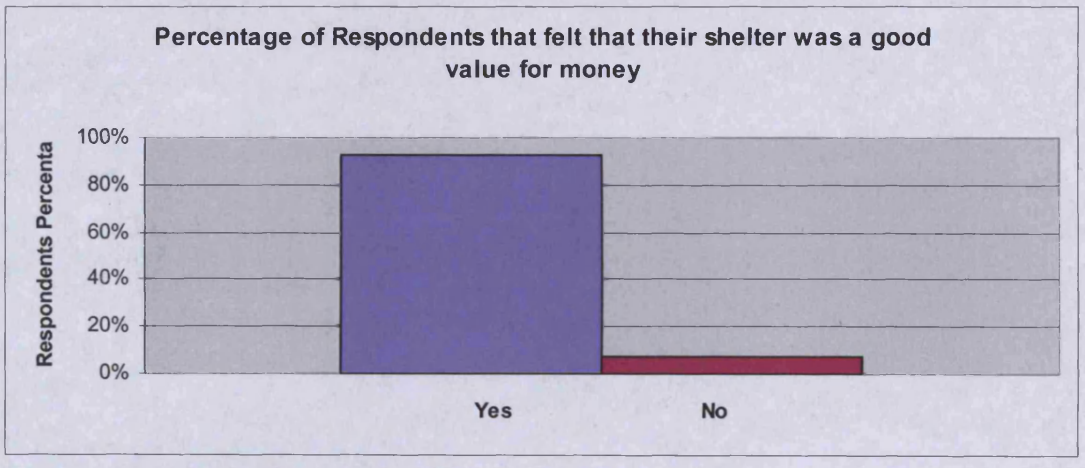


Figure 5.87

Impact of budget: in response to the question on whether the respondents thought that budget affected the planning and choice of materials used, a larger percentage of the respondents ticked yes and this is shown in figure 5.88 given the following page. This

indicates that in this housing development as well most people think that the budget has a lot of bearing over the planning and choice of materials indicating that they think that less budget would give less.

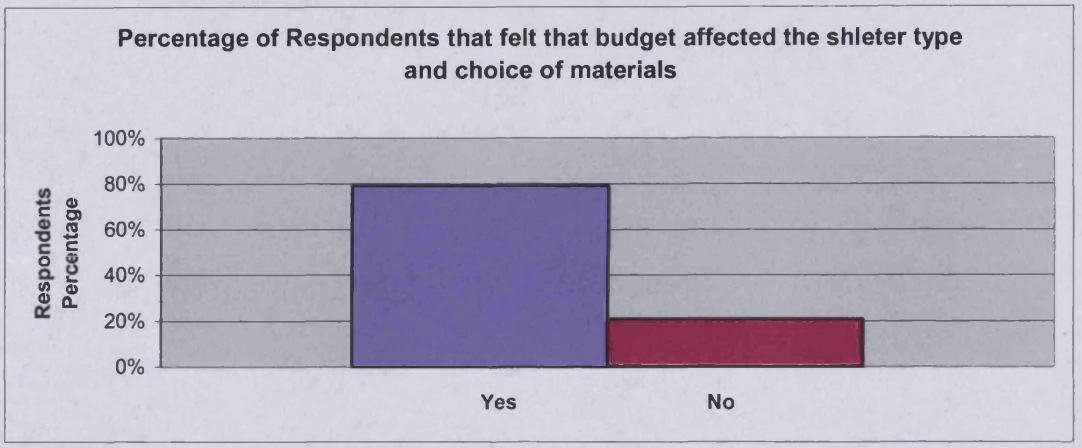


Figure 5.88

Proportion of investment put into their house: in response to the question on what proportion of their income the respondents spent on their house from the options given, a larger percentage ticked 10-15% and the results are shown in figure 5.89 below.

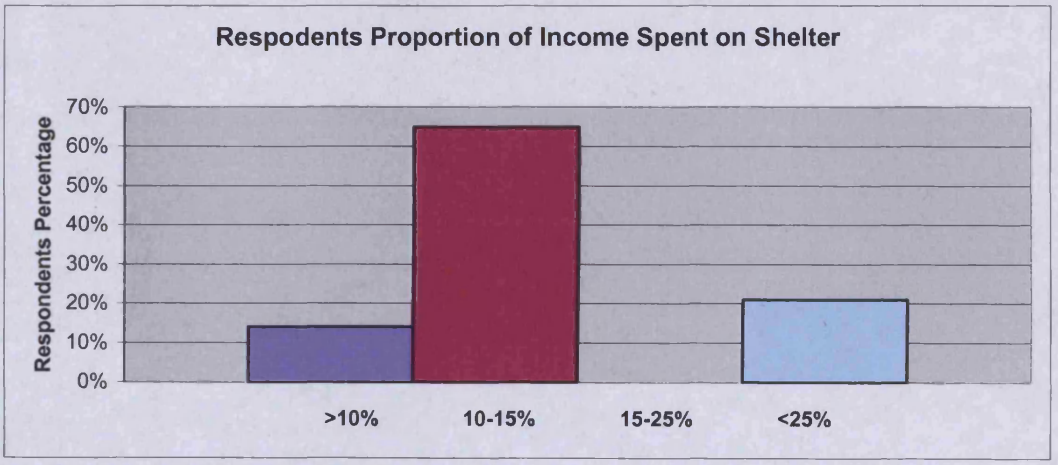


Figure 5.89

In response to the question what they spent their income mainly on, most respondents ticked on both maintenance and cooling/heating.

The results are shown in figure 5.90 given below.

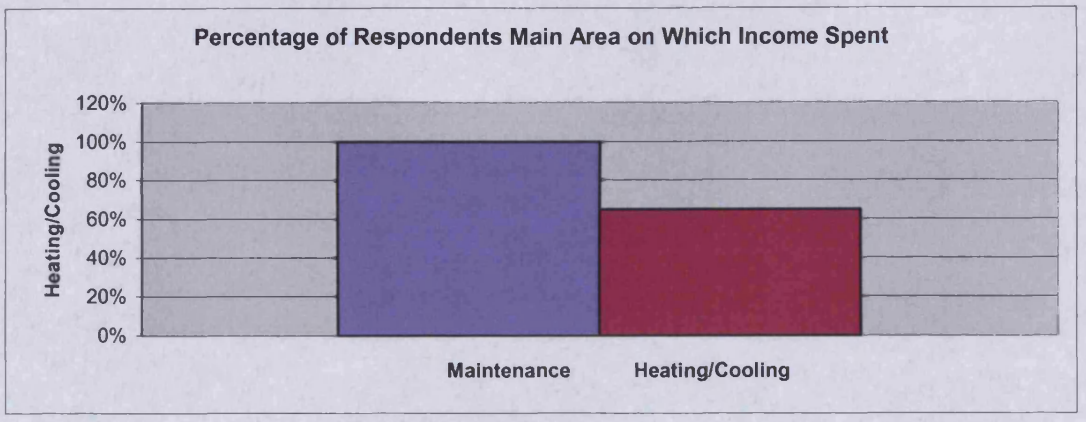


Figure 5.90

Shelter Investment Cost Versus Ten Years of Running Energy Cost

In order find out on which area households spend their money on whether the house or the running energy, a comparison is drawn between the likely costs of HIG shelter and tens years of running energy costs and is shown in figure 5.91 in the following page. The initial investment on the house is gathered from the advertised sale prices on HIG houses around the areas of Defence colony and Greater Kailash where a concentration of HIG units. From inquiries on market prices for HIG units in areas like Greater Kailash and Defence Colony minimum prices of properties started from Rupees 100000000 (£1250000 approximately) depending on the property size and whether detached and semi-detached. Based on the questionnaire survey data the average annual electricity cost comes to rupees 72000 (£900 approximately). The figure 5.91 drawn below shows that at present the investment cost of the house is higher than the money spent on electricity for a period of ten years despite high dependence on mechanical systems. (Most urban households irrespective of income group choose materials like brick and concrete which is energy intensive in their production).

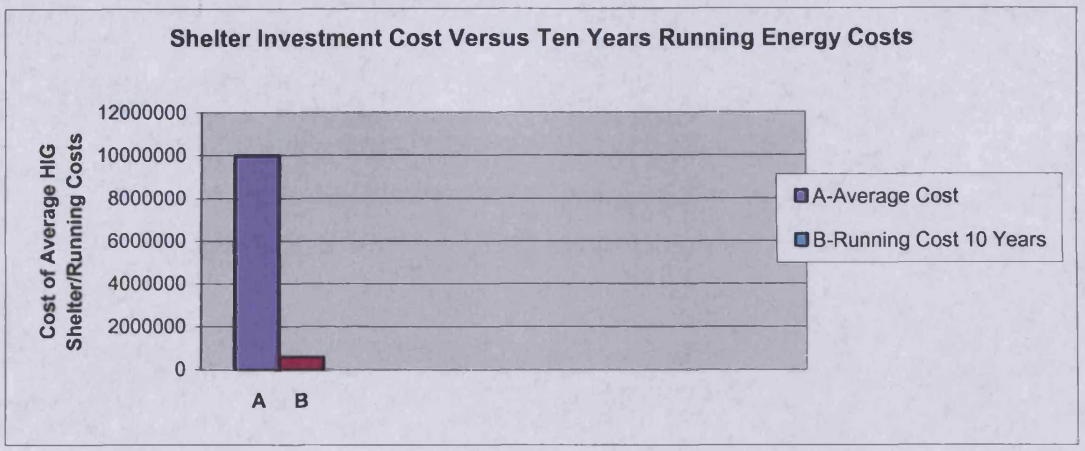


Figure 5.91

This study suggests that high-income group category is a financially secure category and hence their lifestyle choices are based on preference, which in turn dictates the technology and materials adopted for shelter units. Most these developments use energy intensive conventional materials, which are preferred among this group, and although there are many more choices available today, there is no evidence of their implementation among these households. Among this group there is a relationship between affordability and cost of shelter. However since cost effectiveness has been rated as an important aspect by all income groups indicating that if more cost-effective options with similar qualities are available and user are made aware of these options they might adopt other options.

Environmental Aspects: this section will look at respondents thermal comfort ratings during summer and winter, type of cooling systems adopted in order to gauge comfort and indoor thermal conditions and level of dependence on mechanical cooling. (As mentioned before according to data collected in literature review and personal observations in stage A case studies, most households use mechanical cooling, however heating systems have only started being adopted. Hence in this study as well only cooling systems will be looked at). The question on respondent's willingness to reduce dependence and use of mechanical systems if conditions improved through alternative ways was put into the questionnaire in order to gauge mindset and willingness to adapt.

Environmental Hypotheses *There is a relationship between thermal comfort, energy use and shelter*

Questionnaire survey data

User rating of indoor comfort: In response to the question on rating general indoor comfort on a scale of 1 to 5 where one is very poor and 5 is excellent, a larger percentage rated it as excellent and is shown in figure 5.92. This indicates that the HIG respondents are quite satisfied with the general comfort conditions of their dwelling units.

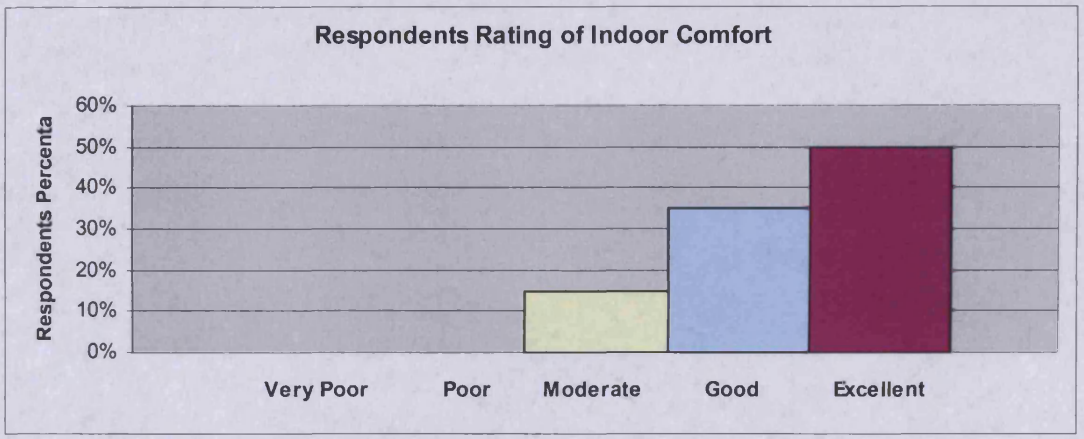


Figure 5.92

In response to the question on rating overheating in summer on a scale of 1 to 5, where 1 represents never and 5 represents very often, there was a mixed response among the respondents and is shown in figure 5.93.

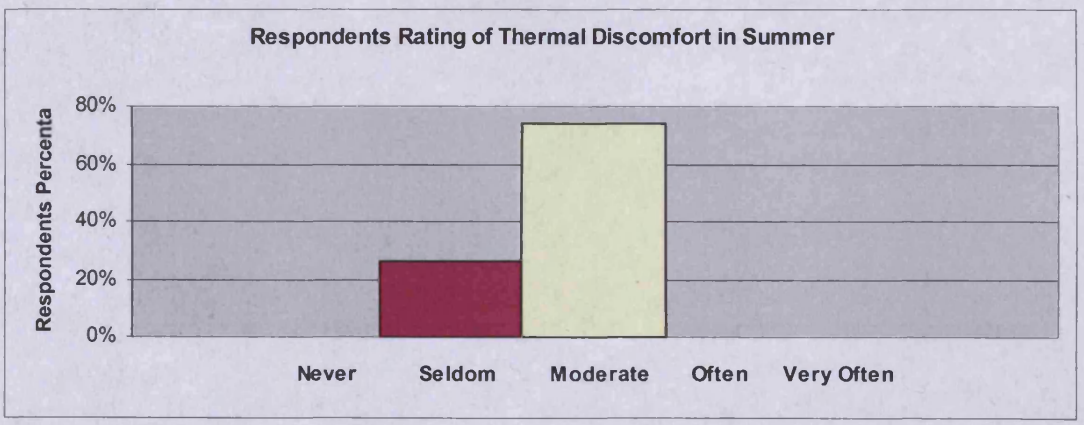


Figure 5.93

In response to the question on what type of cooling systems they used from the option given, all respondents' ticked fans and air-conditioners, a small percentage ticked coolers as well. The results are shown in figure 5.94. None of the respondents ticked under other. Out of the respondents owning air conditioners, 16% used it all day, 84% ticked mainly at night and 66% ticked frequent use.

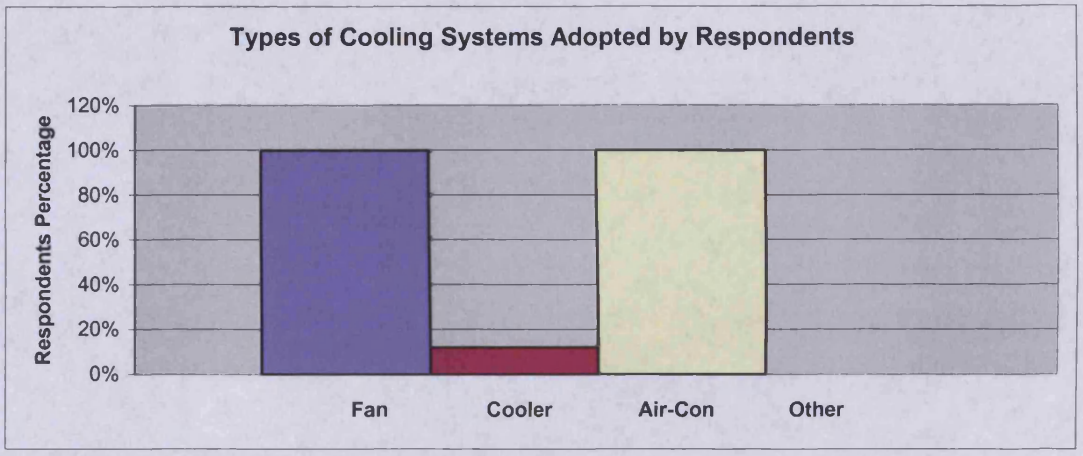


Figure 5.94

In response to the question on rating overcooling in winter on a scale of 1 to 5, where 1 represent never and 5 represents very often, most of the respondents have rated it as seldom and moderate and is shown in figure 5.95 below.

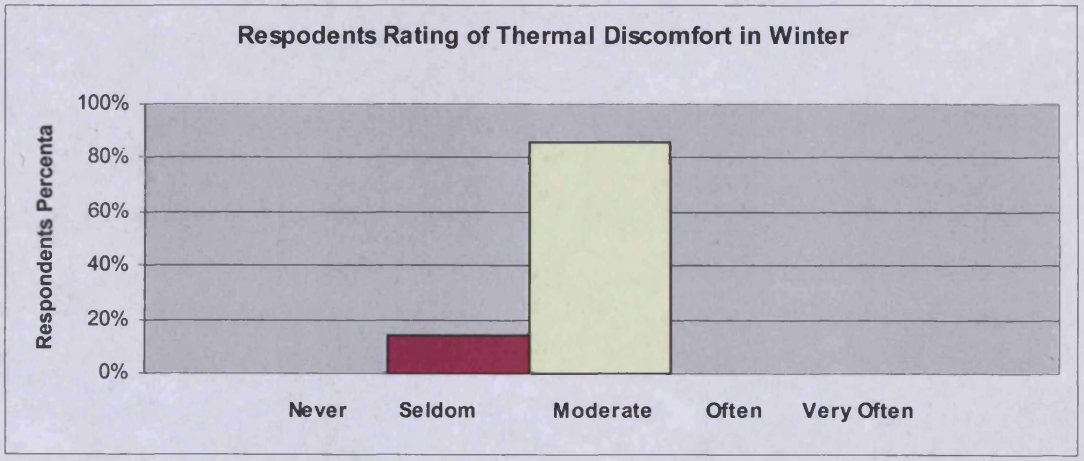


Figure 5.95

Most respondents use air-conditioner among this group but in response to the question on given the option of improved indoor temperature through improved planning, maximum

use of ventilation and climatically suitable materials would they reduce dependency on mechanical systems, a large percent of the respondents answered yes as shown figure 5.96 below.

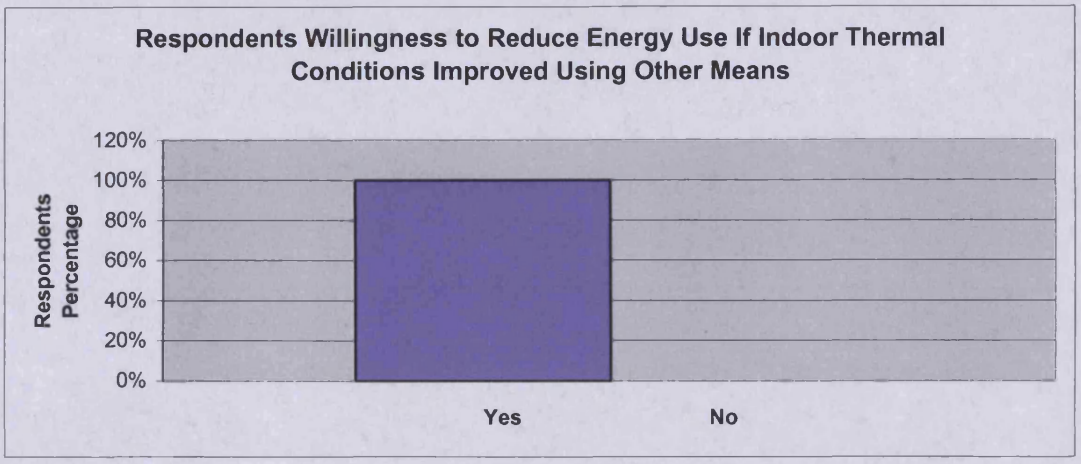


Figure 5.96

Based on the data collected in this study the lifestyle of an average HIG household is depicted in the figure 5. 97 given below:

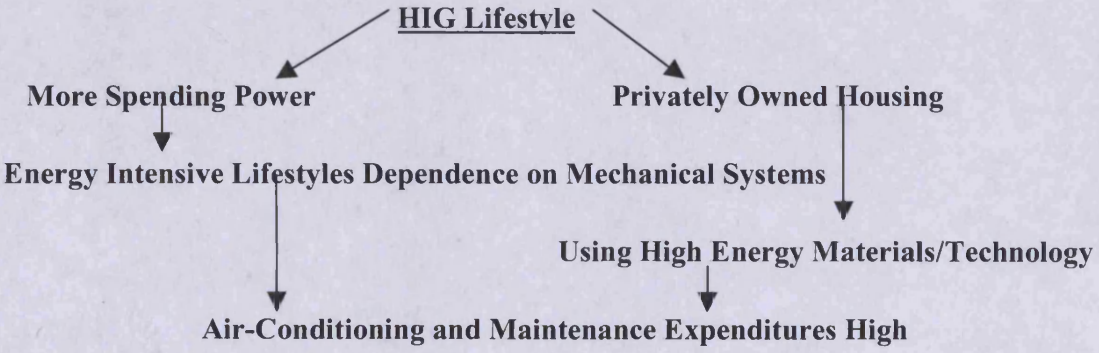


Figure 5.97

In this study the HIG respondents have rated indoor thermal comfort as fair. However high dependence on mechanical systems suggest that shelter choices made by this group at present are not sustainable despite having the resources to choose more efficient options.

Technological Aspects: In this section the materials adopted, their properties and user preferences and satisfaction levels with the materials used will be looked at.

- **Technological Hypotheses** *There is a relationship between conventional building materials, appropriate building material technologies and shelter.*

Questionnaire survey data

The questionnaire responses suggest that the residents are aware of the building materials used in their house and 72% said they were happy with the materials used while 28% said they were unhappy with the materials due to high costs of building materials, high maintenance costs and but poor quality. The results are shown in figure 5.98 given below.

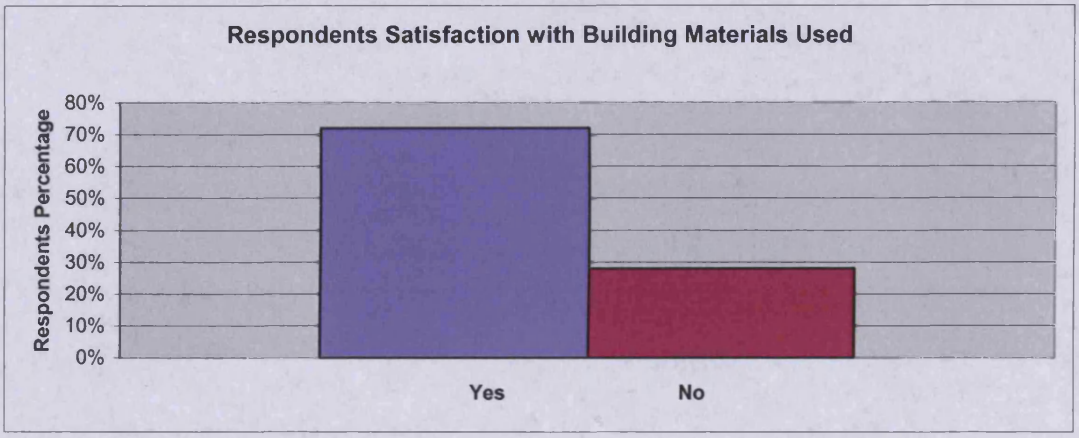


Figure 5.98

Brick and concrete are the main building materials used for the structure which have a high carbon content as coal is the mail fuel used for production. This category tend to go for materials recommended by the Architects and builders which are generally brick and cement like in the case of the MIG shelter development, although the interiors are more lavish using materials like marble and granite resulting in extra expenditures.

As discussed in the literature review section, there is evidence of alternative technology and materials developed by research institutes, which are also supported by the government. But in this study however there is no evidence of the use of alternative materials developed.

Brief discussion on Political aspects of shelter among the three income groups

Since this study is mainly concerned with the micro aspects of user needs, the macro-aspects of shelter scheme and polices are not looked into in these case studies. However this section will briefly look at present political influence on shelter developments among all the three income groups, based on structured interview with the DDA official and the secondary written data gathered during the visits to the DDA office block.

- **Political Hypotheses** *There is a relationship between public participation in government shelter schemes and their more successful applicability.*

Middle-income group: According to the Delhi Development Authority (DDA) official most of their MIG dwelling units have been entirely planned and executed by the DDA and in some cases old surveys are consulted to attain some idea of user requirements. In response to the question on public participation in shelter developments the DDA official's response was that in this and most other MIG developments the houses are mass executed and designed by the DDA architects and engineers. This suggests that there is no active participation or inputs from the prospective clients. Basant Enclave is a good example of a MIG development executed by DDA, and the flats advertised after with properties like optimised indoor space, comfort and privacy to prospective households. However a large percentage of the respondents of this development felt that their needs and requirements were not taken into consideration in the houses built for them. Also there is absence of awareness among the respondents at policy level shelter schemes and programs, which needs to be addressed through more accessible, transparent measures adopted by governing bodies.

Economically weaker section and low-income groups: The public sector has taken many measures to develop and implement housing schemes that promote adequate LIG/EWS housing in urban and rural areas. DDA plays a significant role in EWS/LIG and MIG shelter development in Delhi. But despite all the support and housing policies there is housing shortage and quality of existing shelter is poor especially among this group. In response to the question on public participation in shelter planning and development, the respondents responses were no. According to the DDA officer interviewed, although these schemes do not involve active public participation, they have been designed to tackle their needs and improve shelter and infrastructure conditions. Furthermore data collected suggest some schemes are not implemented, for instance the Central Slum Improvement Act, 1956 was enacted and first applied to Delhi and slum removal was discouraged. However in the case of case study II, according to respondents the authorities are sending eviction and relocation notices to the inhabitants. According to the camp representative not everyone in this settlement would get a place in the relocated site, and that the rehabilitation scheme had

a cut off date January 31st, 1990 as its deadline and later settlers cannot make use of its provision. Only those who settled before 1990 had received identification cards known as ration cards and those who have ration cards would be allotted a plot of land in a new settlement, a plot area of 18sqm. Which means that others who are evicted from there will have to find their own place somewhere else. Most probably these people will resettle in some other open land belonging to the government or other agencies, only to restart the whole cycle of illegal squatter settlements and evictions. Thus the public authorities have not accessed the full impacts of the relocation. In this study there is no public participation in shelter schemes concerning them and their more meaningful applicability.

High-income group: The public sector is more involved with MIG, EWS and LIG shelter developments. But in the case of the HIG shelter developments the private sectors plays a more important role, which includes private architects, contractors and builders. However macro level shelter schemes, policies and programs also have impacts on this section of the community since policies and schemes supporting more efficient developments affect all sections of the community. In addition being an integral part of an urban community impact on one section is likely to directly or indirectly affect the other sections. Policies and schemes like the land ceiling act affect all sections of the community and programs like slum improvement programs improves the urban environment in general and therefore affects all sections of the urban community.

5.7.5 Summary:

The high-income groups respondents expressed satisfaction with the general quality and comfort of their shelter and aspects like design, space, planning and location are not compromised. High-income groups respondents seemed to lead energy and resource intensive lifestyles with higher dependence on mechanical systems as compared to middle and low-income households. High-income lifestyle choices are what other income groups are likely to aspire for and graduate to in future. Also, in future operational energy use among this group is likely to increase further if temperatures rise and indoor conditions deteriorate. Hence at present high income households are not sustainable and future scenario unlikely to improve if present trends continue. However, all the HIG respondents

agreed that if the indoor conditions are improved using good planning and passive systems are introduced then they would reduce the use of mechanical systems.

Most of the high-income shelter units are built by private builders and designed around the client's needs and requirements. However most often clients tend to choose from what the designers' offer and hence private builders, architects and planners concerned play a significant role not only in adopting efficient technologies and passive planning systems but also informing and educating the client. Since cost is not an issue for this group, they can afford to set up efficient systems like solar heating, which although incur higher short-term expenses but are likely to provide more long-term savings. Thus, there is lot of scope for successful implementation of alternative materials and efficient technologies developed by research institutes among this group.

The priorities, limitations, opportunities, key questions developed, summary of conclusions and recommendations made for further study are discussed in Chapter VI.

Chapter VI

Discussion, Recommendations and Conclusion

6.1 Introduction:

This chapter discusses the results gathered from the six case studies conducted and addresses the key questions, which were developed in chapter I to guide this study. This chapter concludes with a summary of conclusions and recommendations for further study.

6.2 Discussion: in this chapter the discussions focus on sustainability of urban shelter settlements in relation to short-term socio-economic needs of shelter and long-term consequences of present actions on the environment. The literature review provided the background on local and global concerns of sustainable shelter. The case studies helped to develop the understanding of local shelter needs and shelter processes undertaken at various income levels. The priorities, limitations and opportunities identified in literature review and case study findings are discussed in the following sections.

Economic priorities, limitations and opportunities identified in this study

Cost of shelter- this study suggest that people tend to pay more attention to the economic factors of shelter, hence in order to generate awareness and interest on issues concerning people's lifestyle choices and sustainable development, shelter issues need to be associated with immediate costs and long-term economic savings.

The main barriers to providing basic shelter according to data from the literature review, case study respondents and public sector officials interviewed are mainly fund and resource constraints such as inadequate budget provision, land acquisition problem, difficulty in providing services, limited institutional capability, lack of access to institutional finance, shortage of materials etc. Despite many cost and energy effective options, and the abundance of manpower, shelter costs have risen over the years. Therefore better planning and management of funds and resources are essential elements of the shelter planning process.

Due to socio-economic factors such as unequal distribution of wealth, poverty, unemployment, rising construction costs, lack of access to land and rapid growth in urban

population, the poorest section of the urban community often compromise their basic day-to-day needs, which includes access to basic shelter.

The middle-income group have more awareness, capacity, means and access to take loans, but most of the low income and economically weaker sections of the community have less confidence and awareness and, also often no assets to take loans against. Despite government subsidies and low interest loans, the poorer section find paying back their loans and interests difficult since earnings are meagre. On the other hand higher income groups are adopting more lavish and resource intensive lifestyles. Since shelter affordability is not an issue this group.

This study suggests that the low-income groups and the economically weaker sections of the community are most affected by socio-economic conditions in urban as well as rural settings. Mostly employed in the informal sector they support the urban framework at the grassroots level. However, the present system is not being able to support their basic shelter needs. Individuals who cannot afford formal shelter often turn to informal shelter such as squatter units, rental or otherwise. As discussed in the previous chapters, squatters are more accessible since they are built on any vacant land, re-use building materials collected from demolition sites, and other forms of waste materials. Hence they also significantly reduce landfill waste, thus they are also an intricate part of informal waste management system, which has not been formally integrated into the urban plan.

The effective and resourceful re-use of building materials in such settlements within fund constraints is something planners, designers and local authorities responsible for shelter and service provision should respect and learn from. Instead of demolishing existing squatter sites shelter authorities and designers should work with these communities and apply simple measures from research findings to improve their and their immediate surroundings. For instance as discussed in literature review chapter, research suggests that simple low cost actions undertaken such as painting the roofs and walls white can reduce indoor temperatures by a few degrees.

A review of public sector shelter activities and programs in the past and studies by various individuals suggest that public sector targets aiming to provide shelter for all have not in been achieved in the past and cannot realistically be achieved in the present state of conditions. Formal shelter remains inaccessible to a large number of the low income and economically weaker groups, but those who do manage to receive accommodation in public sector mass housing developments find it unsatisfactory in terms of quality and comfort.

Due to high land prices in urban centres squatter relocation projects are often located at the city fringes far away from employment opportunities and public transport. One way of addressing this problem and also attracting incoming migrants to a relocated site is to provide additional employment opportunities formal and informal in the new location. Such as- locating new shelter units near existing employment sites and industries and creating waste recycling units and space allocated for sorting, recycling, giving them benefits of cottage industries and selling of finished goods be integrated into the new settlement plan. Any additional revenue generated from these could be used for further development of the site or service provision.

Literature review data suggests that poverty elimination is a priority in India, required to improve quality of life its communities. However literature review on case studies from various countries also show that poverty is not the sole quality indicator and counties like Columbia, China and Costa Rica are good examples of countries acquiring standards far more than their per capita incomes. These country models are good practice examples, which could be adopted effectively in this country as well.

Environmental priorities, limitations and opportunities identified in this study

Comfort- this study recognises user comfort as a priority aspect, that not only affects the quality of indoor life of an individual but also if inefficiently addressed has negative impacts on the environment in terms of energy and resource use and toxic emissions. Although comfort embodies many aspects, this study has focused mainly on the thermal aspect of comfort, infrastructure services and the impacts on the environment associated with it.

The middle-income and the high-income group case study respondents rated thermal comfort as moderate and satisfactory. But the economically weaker section and the low-income group case study respondents rated thermal comfort as dissatisfactory. However in these case studies, when looking at various income group respondents' thermal comfort ratings of shelter, one factor should be kept in mind, which is the use of air-conditioners, which vary indoor conditions. Middle and high-income group respondents use air-conditioners, but since most low income and economically weaker sections cannot afford the costs of the equipment nor running it, do not use air-conditioners. Therefore in these case studies user responses are not an accurate indication of indoor thermal comfort

conditions of various shelter types. However this does indicate that indoor thermal conditions in most of the case studies undertaken are not entirely satisfactory and more well to do households have adopted mechanical systems in order to improve their indoor conditions. At present among the low-income group and middle-income group, use of mechanical systems is relatively lower than the high-income group respondents. However more and more low and middle-income households are likely to adopt mechanical air-conditioning systems due to urbanisation, economic growth of a household and resulting rise of living standards. In addition due to change in atmospheric temperatures and poor thermal property of the house, use and dependence on air-conditioners is likely to increase. The building materials used for construction in all the case studies conducted have been chosen for reasons other than their thermal properties such as cost, affordability, popularity, familiarity, durability and aesthetic value. Also literature review suggests that the trend among public and private planners and builders is to design for building with air-conditioning. Therefore effective use of site properties, weather conditions and thermal properties of building materials are still not completely optimised. Having said that, it is important to point out that the domestic running energy use by only a small section of the middle and high income group of the community is much lower than the embodied energy used in the construction of shelter and production of the building materials used for shelter. This study suggests that the present system of shelter provision are not sustaining the needs of the user and where sustaining are not without consequences on the environment in terms of resource depletion and emissions. Therefore present shelter inputs and outputs not only have impact on the short terms micro needs at the user level but also have long-term consequences at the macro level.

In order to address the issues of comfort and efficiency, a clear understanding of user requirements and environmental benefits and consequences are essential. To support any action undertaken, awareness and education on the benefits of alternative options adopted need to be given to users and builders (for builders to adopt for efficient options and user to accept these changes).

Social priorities, limitations and opportunities identified in this study

Communication - this study identifies communication between the planners and individuals of the community, as a priority, if we are to address shelter needs. Lack of

interaction between the local authorities/planners and the community or community representatives is evident in the case studies conducted. Communication is vital in order to identify relevant issues and priority areas through valuable input on user concerns within a larger framework & inform builders/planners/local authorities to enable them to integrate user needs into the shelter process. User participation in shelter provision is one way of communicating with people, empowering people and understanding individual needs, in areas, which directly concern their immediate needs. Although individual needs may differ the aim of communication and participation is to realise, select and address more common issues, realistic requirements and priorities affecting the general well being of a larger percentage. Communication provides a portal for interaction leading to more discussion, inputs, and exchange of ideas and also helps dissolve social/cultural barriers.

Among a larger percentage of the case study respondents awareness to alternative building technologies, shelter schemes and polices is poor, an indication that most respondents are not aware of the various options available to them. Communication through participation, workshops, interaction and use of media would also generate awareness among people encourage them to make more informed and efficient choices. Awareness in turn would lead to responsibility for actions undertaken among communities, which can help confirm long-term sustainability. Also in order to make suitable choices adequate knowledge concerning priorities and limitations if any, is required.

Awareness levels to various significant issues such as efficiency, shelter programs and policies etc among all the income group case study respondents were low, indicating that literacy levels had no relevance to awareness levels. Hence alternative informal ways of providing awareness education will need to be adopted in order to target all three sectors of the community. On the other hand builders/planners/local authorities concerned with shelter process also need to update their knowledge base and skills though training and regular appraisals and surveys. Gathering information from people such as large-scale survey that would be represenatative of a larger section should be adopted from time to time. User inputs through opinion polls and surveys would provide quality feedback on preferences and shelter needs and also help generate more awareness among respondents on various current issues concerning shelter.

Political priorities, limitations and opportunities identified in this study

Prioritisation and effective implementation- according to the literature review and the case study finding, prioritisation and effective implementation of shelter schemes and policies, based on understanding of micro need of the user and macro needs of the environment need to be adopted. The discussions on the social, economic and environmental priorities illustrate the importance and significance of adequate understanding of the relationship between people, shelter and the environment by planners and policy makers. This study suggests that Government policies on shelter over the years have focussed on providing shelter for all sections of the community especially the economically weaker sections and the low-income groups. However, there are major gaps between demand and supply leaving a large percentage without access to basic shelter and services. In addition the quality of shelter and the impacts of rapid and inefficient shelter development on the environment are often overlooked.

Policy level support can promote sustainable shelter through awareness generation, promoting more efficient lifestyles choices and promoting adoption of best practice financial incentives such as subsidies and tax rebates to more efficient buildings and production units. Also policies should create energy standards and energy consumption limits in construction and operational use though regulations and building byelaws.

As already discussed in the social section of the literature review and also evident in the case studies conducted, the communication between public authorities and people at any level or easy access to official information is absent. This in turn discourages accountability, transparency and responsibility of the respective public bodies. For instance, the five-year plans for housing suggest that they are not specific on how they are going to be implemented. The official reports on some the shelter targets and the achievements made show that in certain areas achievements are nil with no account of where the funds have been channelled. Indicating absence of accountability and transparency of the public bodies, which should be addressed by adopting a more open book approach to policy development and implementation. This in turn would reduce the rate of administrative corruption to a minimum.

Technological priorities, limitations and opportunities identified in this study

Building materials- the use of building materials need to be given consideration to, in terms of quality, thermal properties, cost, durability, aesthetics and the embodied energy content of the materials used in shelter. The properties mentioned have impacts on the user and the environment. According to the literature review data and the case studies the public and private sector mostly use conventional building materials like aluminium, steel, cement, bricks and concrete to name a few, chosen with some consideration towards budget and user preferences. However the long-terms implications of their use on the environment are not always considered. For instance, conventional materials like cement and brick have a high-energy content due to inefficiencies in production along with long distance transportation. Therefore embodied energy content in present building materials used is likely to be higher as compared to present running energy in the domestic sector. Domestic running energy is likely to be lower, mainly because larger percentage of the population cannot afford mechanical systems as seen in the case studies conducted. According to case studies middle income and the high-income group household use air-conditioning, however they are a smaller percentage of the urban community. Therefore building materials used for shelter construction are likely to contribute towards a significant percentage of the total energy that buildings use.

In order to help gauge, compare and depict the likely scenario of ten years running and embodied energy content of a basic middle-low income non air-conditioned urban house, a graph comparing the two values taken from a study example by a research organisation in India called Development Alternatives has been drawn in figure 5.1 given below. For the purpose of this comparison, the values from a study conducted by Development Alternatives using the Eco Rating Tool to determine embodied energy requirement of a commonly built brick and concrete plaster house has been used. The value is taken as 720kwh/msq. The operational energy per year is taken as 8kwh/msq, which is energy reading of lower-middle income and low-income households. In figure 6.1 in the following page, A represents the value of embodied energy of a common brick and concrete plaster house in India taken as 720 kwh/msq and B represents a total of ten years operational energy taken as 80kwh/msq (Development Alternatives, Basin News, 1999).

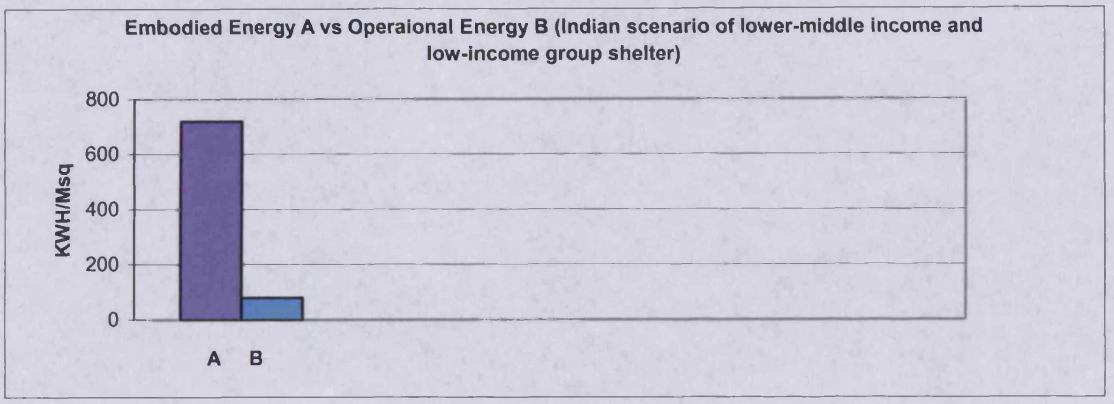


Figure 6.1

According to the figure 6.1, the embodied energy A is much higher than the operational energy B used in a period of ten years. Although this figure in based on just one house type, it is an indication of the current domestic shelter energy scenario since the materials used are common and the running domestic energy used among a larger section of the urban community is still comparatively lower. Only in the case of high-income group households due to higher dependence on mechanical systems the embodied energy versus running energy in shelter would be more or less equal. As mentioned in the case study discussions, a trend, that other income groups are likely to adopt as their socio-economic conditions improve and, if indoor thermal conditions remain poor and temperatures become more extreme in future. Hence the percentage of operational energy use is likely to rise in future as is depicted in figure 6.2 below. Therefore operational energy of shelter cannot be neglected either and consideration to efficient planning such as passive planning need to be integrated during the planning stages to reduce the need for additional heating/cooling systems. Therefore buildings for the present and future not only need to have low embodied energy but should also adapt to the climate and minimise the operational energy use and thus both issues need to be simultaneously addressed.

	Embodied Energy	Operational Energy
Current Scenario	**High**	**Lower**
Likely Future Scenario	**Lower**	**High**

Figure 6.2

However, the literature review findings and discussions in the environmental section of chapter III suggest a likely future scenario where embodied energy content will become lower if production units and construction processes become more efficient due to local and global pressures. At present according to literature review alternative building material options, are not being successful in wide scale applications due to a gap in production and effective large-scale marketing of the product. Use of building materials inefficiently produced increases the embodied energy content of the building. Therefore effective marketing strategies would ensure long-term success and sustainability of the product. Also in order to promote the use of alternative technology, government bodies should where possible reduce or exempt interest payment on housing loans especially among low-income households.

This study suggests that conventional materials on the other hand have successfully established their place in the construction scene. However the production of most conventional materials are inefficient resulting in high carbon emissions and thus high-embodied energy content. As already mentioned, often the final products also cost more due to inefficiencies and long distance transportation. Despite inefficiencies, case studies suggest that conventional materials are more popular along respondents and builders and therefore likely to stay in the shelter market for a long time. Therefore their production needs to be made more efficient. Also conventional materials like brick are one of the largest employers in the construction industry. Therefore industry research should be directed towards the use of waste materials in production of brick and the efficiency of production units should be made compulsory by a certain time period and fined thereafter.

Areas with opportunities where effective changes can be adopted: the discussions carried out on various aspects of shelter in this section point to the important role of organisations, technology and governance in the successful implementation of existing opportunities within the shelter process. These changes can help reduce investment costs, ensure more than one benefit/benefactors and simultaneously address long-term impacts on the environment.

Role of various organisations: since individual needs are different, so are the needs of the different socio-economic groups and therefore any action adopted to address the needs of different income groups cannot always be the same. With context to the low-income groups

and economically weaker sections shelter needs, public sectors are responsible for formal shelter provision. However case studies indicate communication between local authorities at the grassroots level is absent and wariness is mutual. NGO's have more access to and better relationships with the poor. Case study of the low-income group houses in Kerela demonstrated a successful relationship between the two. Hence more NGO's should be given decentralised control over shelter schemes and programs at the grassroots level.

In the case of the middle-income groups, case studies show that public sector has mostly been responsible for planning and execution of shelter. User participation in the formal shelter delivery process seems to be low or absent. Most of the shelter units catered for the middle-income group are mass-produced and put in the market for sale. According to this study most choices or preferences are based on location rather than other factors like thermal comfort or aesthetic value. However, mass construction and total public sector control could be used to an advantage in certain areas such as passive planning and the use of more efficient materials in shelter by making such practices compulsory among all shelter authorities.

In the case of the high-income group, shelter units are mostly privately owned and built and executed by private builders and architects. Therefore in this case the design is based on user needs and requirements, and the clients are consulted at every stage of the development process. However case study responses among this group also show low awareness to current issues and alternative options suggesting that the clients are not always well informed. Most often the initial designing and materials specifications are initiated by the planners and builders and executed on client consent. Thus in the case of the HIG developments the private sector plays an important role in informing the user. In order to promote sustainable development among this group, the user needs to be well informed and the builders and architects need to practice and adopt more resource and energy efficient planning and technology. Therefore designers should play a more active role in promoting sustainable development by introducing and promoting more efficient planning and materials to clients assisting them to make more efficient choices. Designers should get more insight into user needs, which can effectively and successfully be integrated with cost and energy efficient materials in order get sustainable shelter solutions. For instance, among all the case study respondents cost and affordability of shelter are important considerations in shelter development, hence the use of cost-effective materials

from efficient alternative options would aid in reducing shelter costs but without compromising on quality and with less damage to the environment.

As stated before government bodies should also encourage private builders by giving tax exemptions and subsidies to those who adopt more efficient technologies. Also, architecture/planning schools should introduce and encourage sustainable aspects of design to generate more awareness, instil a sense of responsibility among designers to make more efficient choices.

Role of technology: the availability of technologies producing more efficient and accessible building materials to choose from can play an important role in the dynamics of sustainable shelter in urban India. As already evident from previous discussions in this chapter the technologies adopted not only have impacts on the users but also on the environment. Since popular building material adopted by the private sector, public sectors and the users are mostly resource and energy intensive.

In the case of middle and high-income households' building material choices are based on preference, popularity, accessibility, familiarity and quality. Whereas in the case of squatter settlement respondents choices are limited due to financial limitations hence most building technologies and materials used come from re-use and recycled products. Hence perhaps by default are more efficient. Therefore research should be promoted on possibilities of easy re-cycling of waste from buildings for instance existing practices like the re-use of waste brick material in brick and ceramic tiles production should be promoted. Especially for the benefit of the economically weaker sections and the low-income groups. Private and public sector support though large-scale adoption of re-used and recycled materials would provide more opportunities for the informal group of waste collectors and recyclers and also protect the environment.

Alternative and cost-effective technologies and materials are still in their initial stages of acceptance and need to be propagated on a larger scale though advertising and applications in mass public and private shelter. According to the interviews conducted of public planners, the use of new more efficient technologies have not picked up due to failures resulting mainly from lack of successful technology management, wastage as self-help technologies which were not readily embraced by users due to difficulties and lack of technical know-how.

However there are limitations to technology applications for instance, in existing building only some technologies cannot be applied for instance, use of alternative building materials is not applicable in existing building and is applicable only to new developments. Types of technologies applicable to existing and new buildings are shown in figure 6.3 and 6.4 given below.

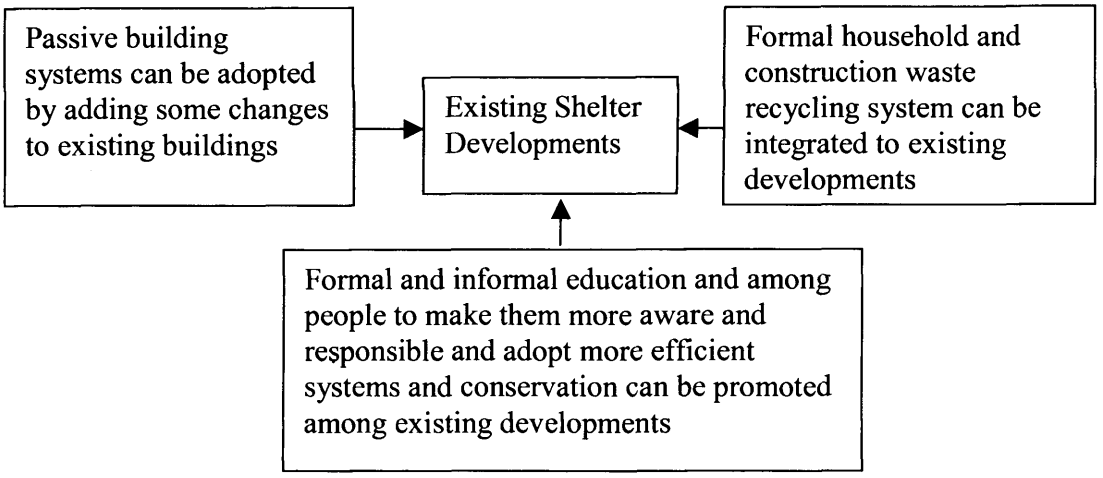


Figure 6.3

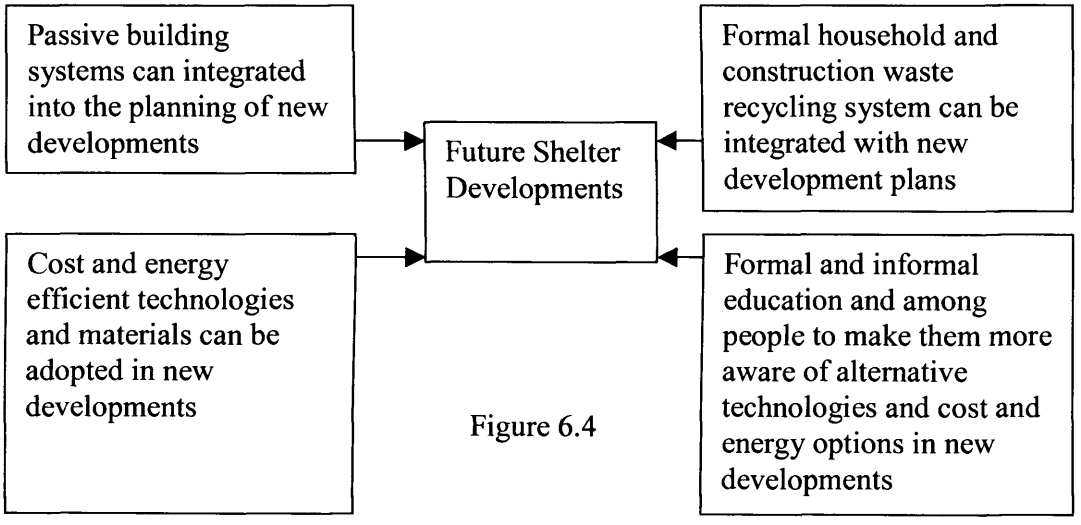


Figure 6.4

Role of Governing bodies: for changes to become effective in the construction industry they have to be supported by government schemes, programs and financial assistance. Therefore in order to effectively address social needs, environmental concerns and economic viability in urban shelter, policy support and user awareness (to bring more acceptance) are essential (applicable to rural shelter developments as well). Already

mentioned builders and architects should be encouraged to adopt passive planning through incentives.

Shelter policies should also support and consolidate existing efficient options such as the existing informal recycling systems into a more formal and organised system which will provide better access to safety guidelines, give the informal systems the label and benefits of a cottage industry, provide fund support and tax exemptions on manufacture and purchase. Building regulation should be revised with preference to the use of efficient, recycled and re-use of building materials that would otherwise be dumped in landfills.

As discussed before, since shelter policies and schemes are developed for the benefit of people, communication between the different representatives of public bodies and people is essential. Public awareness and their feedback to the schemes developed is very important in order to develop schemes, which will address the country's needs more effectively. Participation, interaction, access to information and awareness would also encourage transparency and accountability of governance, which are important aspect of sustainable shelter development as well. Based on the findings of this study figure 6.5 given below depicts how government bodies play an important and a central role in use of technology in shelter process and awareness generation:

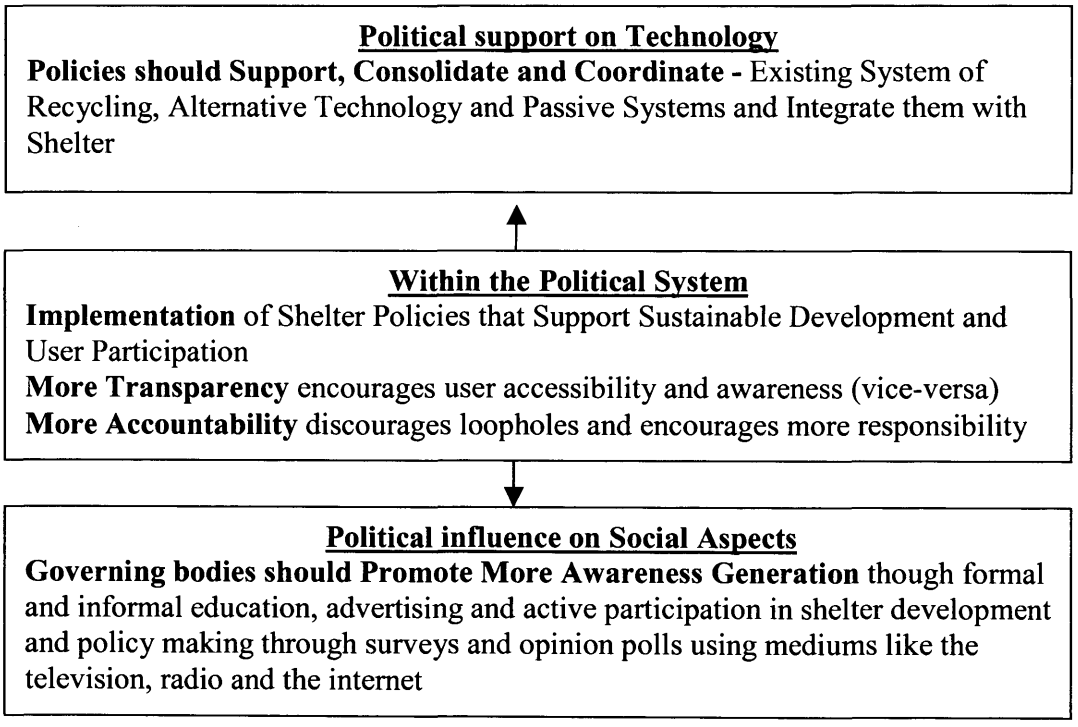


Figure 6.5

Recommendation of a Model to assist user in assessing sustainability of urban shelter within local an global context:

A simple model has been developed to guide individuals and designers to identify, incorporate and prioritise user needs and choose options, which to a certain extent considers long-term impacts as well. The variables used in this model are based on the study findings, however individual can put in his/her own identified variables. The model illustrated in figure 6.6 could also be tailored to gauge priority issues concerning rural shelter. The model would help developers/planners/local authorities and individuals to identify short-term and long-term issues, enable them to compare complimenting and conflicting issues. Hence assist them in prioritising issues and where possible consider options, which simultaneously address/minimize long-term impacts as well. The sustainable aspects of shelter are to be accessed by looking at short and long-term issues and whether the short-term issues and the action undertaken conflict or compliment the long-term issues and impacts, what that means and how it all relates. The use of the model for the findings of this study suggests that in this study, the short-term requirements share the same concerns of long-term environment requirements of resource and energy use.

The model is as follows:

Shelter Aspects	**Short Term Needs:**	**Present Situation**	**What does it mean?**	**How does it all relate to long-term environment concerns and pressures?**
Environment				
Comfort	Provision of basic services & indoor comfort covering all settlements	Unsatisfactory, poor thermal comfort especially among the LIG/EWS households	Since a larger percentage of the urban population come under the LIG/EWS section, higher percentage live in poor condition & discomfort	Due to lack of effective passive planning and poor thermal comfort, HIG/MIG household are becoming more dependent on mechanical systems, however due to power shortage, they are likely to suffer discomfort, whereas LIG/EWS household connot afford mechanical systems thus also suffer from discomfort. Thus effective planning has to be undertaken not only with consideration to future growth load but in terms of effective resource management, conservation & efficiency.
Bldg/Site Plan	Planning effectively integrating site & climatic conditions to provide comfort & also reduce energy costs & impacts	Most present urban house plans lack integration of climatic & site conditions	This means that passive planning & site properties which would improve indoor conditions efficiently are not being effectively adopted	
Active system	Reduce dependence on mechanical systems due to reasons of inefficiency and low affordability	Growing dependence on active systems among MIG/HIG households	More households are adopting energy intensive lifestyles, but electricity production is not keeping pace	
Passive	Integration of	Use of passive		

system	passive planning & systems in shelter	systems slowly disappearing looking popularity	Although passive planning has been an imminent part of Indian architecture and culture, it is not being applied in present houses	
Service Access/Adequacy	Growing demand for adequacy/ access to basic water, electricity & drainage services	Lack of access to basic water, electricity among the poor and irregular among other groups as well	Demand/supply not balanced.	
City Planning	Plan cities based on future growth load in terms of not only employment & shelter but services like drainage & waste disposal	Most urban areas suffer from inadequacy in terms of basic shelter, employment opportunities, services- a direct consequence of population growth and rural to urban migration	Absence of long-term planning based on present needs &on future growth load in terms of employment, housing and services in urban as well as rural areas	
Location	Location of settlements need to be based on work opportunities, access to service & future growth support plan in terms of service load as well	Although most housing options are now being located in the fringes and are commutable according to MIG and HIG households. However employment opportunities for LIG/EWS households are limited	Rapid growth will result in escalation of existing issues hence a need for long-term planning of cities which will support existing & future growth	
Economic				
Shelter Cost	Reduce cost of basic shelter	Present shelter costs much higher than present income levels specially in the case of LIG & EWS groups	This means that the cost of building materials and land need to be further subsidised especially for the LIG/EWS	Hence in order to deal with present socio-economic, environment and shelter requirements different areas have to be simultaneously addressed & where possible integrated, like creating more employment in shelter, promoting local, labour intensive materials. Provide training in efficient industries & local crafts, invest in marketing of such products in order to guarantee long-term demand and employment. Adopt cost-effective labour oriented technology & materials in mass construction. Generate more revenues in areas, which help promote more efficiency through supportive discounts & schemes.
Shelter Affordability	Provision of basic affordable shelter for the masses, access to land, cost-effective materials & low interest loan	Basic shelter nor options to address that not very accessible to a larger urban section	This means that more and more squatter settlements will come up in vacant sites with minimal or no basic water, drainage and sewage facilities	
Employment Opportunity	Generate employment by supporting labour intensive industries & formal and informal activities of the shelter industry	Higher rate of employment opportunities in the informal sector such as waste recycling, formal construction sectors gradually shifting away from labour intensive activities	This means that more people from LIG/EWS groups are likely to fall under the informal sector, thus more labour intensive trade and industries in construction need to be created/promoted & supported	
Funds & Resource	Need to generate more revenues especially in areas where efficiency	At present fund and resource constraints are evident	This means that more revenues need to be generated & resources need to be used more	

	can be promoted by imposing fines & tax on inefficient practices		wisely and effectively	
Social				
User Requirement	Shelter must be able to provide basic user needs	User satisfaction low	This means that user needs and requirements are not being effectively addressed	Therefore more communicative/interactive ways of informing the public & interacting will have to be invented & adopted in order to help people make more informed choices & promote more public participation in order to inform builder & planners about public needs and requirements. Participation involves people & thus helps identify user relevant issues concerning their needs their inputs on existing potentials, creates a ground for interaction/discussion/sharing of ideas, and improves general awareness along with a sense of responsibility/commitment for action undertaken which is essential in order to confirm long-term sustainability. Therefore participation is essential in order to help undertake decision and actions made to meet social, economic and environmental needs. All these aspects affect user perceptions, which is essential to guarantee any success of long-term application, change and continuity in the area of sustainable shelter.
Improve awareness	Awareness necessary for individuals to make informed choices.	Awareness levels low among all groups of the urban community	This means that level of neither education nor capacity to get information influence user awareness levels. Indicating that people will not go to find information but ways have to be adopted to take information to people	
Participation	Encourage more user participation in the process	Participation in micro as well as macro level shelter activities low	This means that to a large extent people are not involved in decisions that concern their quality of life resulting in a gap in the system	
Technology				
Quality	Quality control is essential in order to provide durability & reduce long-term maintenance costs	Public buildings catered mainly for LIG households in poor condition due to lack of quality control of the materials used	Quality is compromised in many LIG buildings resulting in poor units, likely long-term expenditures & dissatisfaction	The materials used in present houses are not energy efficient and are most often of poor quality, however, still popular among masses. Mainly attributable to reasons of preference based on familiarity and limited or lack of knowledge to alternate option. Indicating that alternate options are lacking effective marketing strategies and access. This suggests that most of the urban developments are also contributing to green house gases & long-term impacts. Although most production units for traditional materials are not efficient as well and need new efficient production units, promoting them would support local economy, reduce transport costs & energy and presence the local heritage skills.
Efficiency	Promote/Adopt use of efficient materials, technologies & production units which support sustainability	Materials adopted in most urban housing are not efficiently produced	This means that popular choices adopted are not based on efficiency thus not a priority among builders and architects	
Embodied Energy	Reduce embodied energy in buildings	Popular materials used in most houses have high embodied energy content due to inefficient production and long distance transportation	This means that most houses are likely to have a high embodied energy content	
Re-use/Recycling	Reduce wastage, integrate & use waste substitutes, promote/adopt re-use & recycling in construction	Apart from wood most construction waste is rarely recycled. However domestic waste is being collected and recycled by an informal network of	This means the recycling network is already an intricate part of the urban community. Therefore the existing informal systems & be easily and effectively be adopted into a more	

		people called rag collectors who collect waste from households which is then recycled and put back into the market	organised, safe & efficient process of waste collection & recycling, into which construction waste can also be added	
R&D	Promote R&D in areas which promote not only more efficiency but have mass acceptance as well thus confirming product sustainability	R&D has produced innovative and efficient options however they lack effective dissemination, good marketing, access, mass appeal and acceptance	This means that alternative options already exists, only more efforts now need to be directed towards informing the users & improving marketing strategies of the products developed	
Conventional materials	Make production of conventional materials more efficient	Are more popular among builders and users however at present are not efficiently produced and therefore have high embodied energy content	Since a larger percentage of urban houses are built using conventional materials present houses are likely to be of high embodied energy content	
Traditional Materials	Make production of traditional materials more efficient & promote them	Traditional materials are neither popular among users nor builders	Since traditional materials are not high in demand the skills to use them are in danger of becoming extinct. Also traditional materials are highly labour intensive	
Political				
Implementation	Need effective program /strategy implementation & transparency of the system for more accountability	Shelter schemes/ programs lack effective implementation &targets largely remain unaccomplished which include quantitative & qualitative targets, while new targets are set	This means present system is not functioning effectively	Shelter schemes and programs although based on short-term requirements also need to be based on public inputs, which address not only user shelter needs but also simultaneously address issues of employment, shelter accessibility and environmental issues. Also in order for programs to be implemented successfully more accountability and transparency need to be adopted within the system, which in turn confirms sustainability of initiatives.
Public access	Public should be more aware of and have easy access to information on schemes & programs concerning them	Lack of public awareness to shelter schemes and policies	More access to information would generate more awareness & inform people about different option available	
Public Participation/ inputs	Public participation/interaction with relevant bodies to integrate their inputs into shelter programs	Lack of public participation and interaction with public body representatives at all levels	This means that policies & schemes are not being based on public inputs & therefore lack user perspective on shelter requirements	
Prioritisation	Shelter policies /schemes should be based on urgency however actions adopted should also address problems in a sustainable manner where possible	Shelter schemes are based on urgency of shelter requirements, however large gaps in demand & supply & without consideration to the environment	This means that neither short-term nor long-term issues are being effectively addressed	

	possible, simultaneously address issues such as employment, fund & resource constrains efficiently			

Figure 6.6

The use of the model in figure 5.6 suggests that in the case of this study short-term needs can be addressed in harmony with long-term issues but in most cases the approaches used to address short-term needs have not considered long-term impacts of inefficient resource and energy use.

6.3 Key Questions Addressed-

Based on the data collected and the results gathered from this study an attempt has been made to address the key questions developed to guide this study. The questions are discussed are as follows:

How are the global actions affecting the local shelter developments and vice-versa?

In the global context more efforts are being directed towards sustainable development, in the area of shelter as well. Global treaties focus on environmental impacts of resource intensive and energy inefficient development such waste, pollution and global warming. Global treaties and agreements by various countries such as the Kyoto treaty have been signed in order to cut emissions, reduce pollution, and reduce waste. While such treaties are essential for sustainable development in the global context local authority/officials argue that in the local context, due to inadequacy of funds, the international standards and agreements often need to come secondary to the fundamental needs of providing food and basic shelter for the masses. Hence in order to address immediate basic needs of people, Government bodies at present are concentrating on achieving rapid economic development however, often with compromises on the on the environment. Global actions towards sustainable development are also of little or no consequence to the masses in India who struggle every day to acquire their basic needs.

However, although present trends and strategies prioritise local needs over global, it is evident that global issues and concerns will have direct and indirect impacts on local issues and concerns including shelter. For instance global changes like global warming, local

changes like population growth, urbanisation and economic development and natural calamities like floods are likely to result in increased rural-urban migration. Also according to the literature review data, global warming may lead to climate change and sea levels are likely to rise with greater impacts on low lying areas like Bangladesh. As a result of catastrophes like floods illegal migration to neighbouring countries like India and Pakistan is imminent. Resulting population rise especially in urban areas may escalate problems associated with population growth such as unemployment, poverty, shelter problems, poor living environments and growth of urban slums. Global warming is also likely to affect shelter comfort if temperatures rise in future. As already discussed, rapid urbanisation and rising resource intensive lifestyles will increase dependence on use of mechanical systems as well.

As a result of these changes a larger percentage of the low-income and the economically weaker sector are likely to suffer the most they lack the funds and resources to adapt to the environmental changes.

Hence in order to deal with present short-term needs, consideration will need to be given to future long-terms impacts and consequences of development. Figure 6.7 shows how global warming might affect local shelter qualitatively and quantitatively.

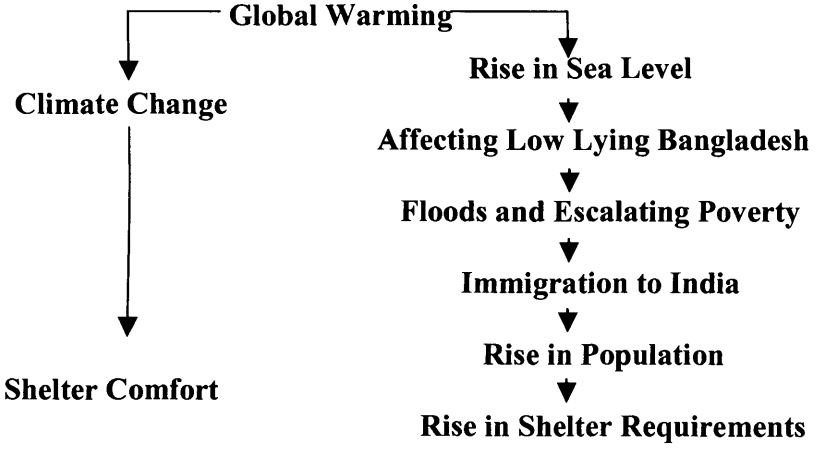


Figure 6.7

What are the various factors influencing urban shelter and shelter types?

Through generations culture and climatic conditions of a region have had the most significant influence on shelter form. However shelter choices are mainly governed by the economic and social conditions of a household. According to the data gathered in this study

communities in urban areas mainly belong to three economic groups, the low-income and economically weaker sections, the middle-income group and the high-income groups. Therefore along with various traditional forms different urban shelter forms catering to these socio-economic groups have also evolved. Such as public houses, which cater to the economically weaker and low-income groups, and the middle-income groups and private detached and semi-detached houses inhabited by high-income groups, also a percentage of economically weaker and low-income group households live in informal squatter settlements. Informal squatter settlements are often a result of fund constraints, rising urban population and government bodies unable to provide adequate formal shelter for all.

What are the major constraints urban shelter developments are facing today in terms of basic shelter provision?

According to the review and case study findings and mentioned earlier in this section, individuals as well governmental institutions and non-governmental institutions identified financial constraints as a barrier to shelter access and shelter provision. According to the officials interviewed, lack of funds, rising land and construction costs play a significant role is basic shelter provision. However this study also suggests that despite evident fund and resource constraints present formal shelter is not based on cost-effective measures. In cases where the costs are cut down, the quality of the units is compromised on. According to the case studies only the high-income group respondents seemed to find present shelter costs affordable, since middle-income shelter schemes are based on instalment payments and most low-income and economically weaker sections live in informal settlements. Even the cheapest options like the site and services option, which has basic, water, sewage and electricity supply with units to be self-built and improved over a period of time is not affordable to the poorest section of the community.

What are the technology options available for a sustainable shelter development?

This study suggests there has been a lot of progress in the field of appropriate and cost-effective technology development however less success has been achieved in the area of dissemination, publicity and marketing of the products. According to previous discussions for a product to be successful, first the buyer must be aware of product and for that it must be well advertised and easily accessible before it gains acceptance among the users. Also, a market research on people's outlook, preference and requirement, limitations etc. is very

essential. According to this study this is not the case with the alternative building materials developed since most of the case study respondents were not aware of these products. Thus the most important factor, which determines the success and long-term sustainability of the product, is absent. The limitations of the applicability of alternative technology need to be addressed though effective marketing, easy accessibility and mass application in formal shelter developments. Public sector control over most low income and middle income housing programs could be used advantageously to advocate and implement alternative materials and technology already developed by research institutes like CBRI, Teri. Which at present are lacking large-scale application. These applications in turn could be used as successful examples promoting alternative materials and technologies to the high income and low-income category. In addition savings made from the large-scale use of cost-effective technologies could be directed towards greening middle-income mass housing schemes or supporting low income and economically weaker section service and shelter developments.

Also according to the case study majority of the respondents from all sections of the community look for the same things in shelter mainly comfort, quality and affordability. Therefore more efforts need to be directed into the study and promotion of appropriate, cost-effective technologies and materials, which provide these properties.

Already stated before, along with adoption of efficient materials and technology attention should be directed towards efficient production of popular materials like brick since they are more popular among users and builders while gradual shift is made towards more efficient alternative and local building materials. Use of appropriate, local, labour intensive technologies would also generate employment and promote local economy integrating shelter and economic development of a community ensuring everyone benefits from it.

Should priority be given to short-term local needs or long-term global implications?

According to this study, shelter shortage manifests itself in expanding squatter settlements which authorities associate with financial and resource constraints. They argue that reducing green house emissions cannot be prioritised and first, basic human needs have to be met. However in order to ensure sustainability of the shelter or other short-term activities adopted long-term implication cannot be ignored. In addition as already discussed long-term consequences will have direct as well as indirect impact on the community, and at some point will become a priority issue requiring immediate attention

before they cause irrecoverable damages. This study also suggests that short-term needs and long term consideration need to progress simultaneously but present actions adopted to address short-term issues conflict with the long-term aspects. The data collected in this study suggest that effective small-scale changes can be adopted at the micro level that also address long-term needs of the environment. For instance, there are options available in the area of shelter development, which are within sustainable limits such as the adoption of alternative, cost-effective, local materials, and technologies, which automatically aid in cutting extra emissions.

6.4 Summary of Conclusions:

The aim of this thesis was to study sustainability in urban shelter settlements in relation to how they respond to global pressures and local needs. The results gathered have been drawn from a range of housing income groups. The key finding will contribute towards a better understanding of the relationship and priorities concerning local and global priorities. They are as follows:

1. The Literature review suggests that-

- Shelter in India is needed to sustain immediate social needs and economic activities.
- Shelter needs- qualitative and quantitative is not being effectively addressed.
- Present urban shelter forms are not efficient in terms of operational energy and embodied energy. Considerations also need be made towards sustaining the long-term needs of the environment.
- Micro and macro shelter aspects lack any form of public participation and inputs, and developed on the basis of perceptions and presumptions of builders and policy makers.
- Despite a variety of alternative options being available in the market most materials used in present urban shelter units conventional materials like brick, which at present are inefficiently produced.

2. The Case studies suggest that -

For Low Income Group/Economically Weaker Section's

- They use little to build in terms of resources and energy, re-use and re-cycle waste materials; hence in that respect they support sustainable principles. However with

improvements in economic conditions and status, this group is also likely to progress on to more energy intensive lifestyles.

- They have rated their quality of life in terms of general shelter comfort as poor.

For Middle Income Group's

- They use more in their shelter in terms of resources and energy use; their dependence on air-conditioners is growing and they have minimum passive design facility.
- They have rated their quality of life in terms of general comfort as good.

For High Income Group's

- Like middle-income groups they use more material resources and energy in shelter. They have a high dependence on air-conditioners and have minimum passive design facility.
- They have rated their quality of life in terms of general comfort as good.

The case studies suggest that the present direction urban shelter is progressing in will not sustain the short-term basic shelter needs of majority of the urban population. Also present shelter processes do not sustain the long-term needs of the environment in relation to energy and resource use.

3. The Attitudes of individuals, industries, local housing authorities and NGO'S suggest that-

- For Individuals: quality of life is important but concerns for the environment are low.
- For Industry: cheaper housing options take priority, but concern for energy and resource efficiency is low (specifically with respect to production of building materials).
- For Government: addressing the short-term requirements of shelter take priority i.e. providing more basic shelter for the masses, but concern for long-term impacts on the environment is low.
- For NGO'S: concerns on social as well as environmental conservation and protection take priority but resources for large scale implementation and dissemination are low.

4. Way Forward-

- Awareness programs- should cater for all, and a top-down bottom-up approach should be adopted.

- House Design- for low-income groups, economically weaker sections, middle-income groups and high-income groups should be made future proof by designing for upgrading and flexibility. Also the use of efficient building materials with durable and affordable characteristics should be promoted.
- Location of housing settlements- mixed land-use planning, access to employment opportunities and other services should be considered while deciding on location of housing settlements.
- Finally all actions recommended above should be given support at the policy level.

6.5 Scope for further study:

This thesis is a preliminary step in the understanding of an integrated sustainable development study of urban shelter in India. Hence more in-depth information from various fields needs to be researched into in order to contributed towards a better understanding of shelter priorities. Also, although the key findings of this study are based on case study surveys, these findings need to be verified and supported through computer simulations and action research. More research, experimentation, pilot case studies and case studies of success stories need to be conducted in order to determine successful applications.

This study has also identified low awareness levels and low involvement of people in shelter programs and policies. Hence more research and investigations are required in identifying barriers to involvement in Governance.

Accessible data on building materials conventional and alternative, their properties of market costs, production costs, efficiency, embodied energy values, recyclable properties and climatic suitability need to be documented and compiled in all regional languages for the benefit of people, builders, architects and planners which will enable them to make more appropriate informed choices.

More study is required in the field of household waste recycling, the processes involved and what is done with the waste. Research needs to be carried on the viability of creating formal recycling networks for the rag collectors and wider markets for recycled products. Also studies need to be conducted and data compiled on safety measures, collection points, marketing opportunities etc. More research on the embodied energy content of low-income, economically weaker sections, middle income groups and high income group shelter need

to be undertaken to guide builders and planners in decision-making and adopting appropriate actions.

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Appendix

Questionnaire Developed for the Case Studies

Appendix 1

Given below is Pilot Questionnaire developed for the stage A case studies:

Name:

Address:

My contact number:

1. Do you think there is demand for a particular type of housing these days?

2. What do you think are the major issues affecting housing today?
   Technological
   Design and Planning
   Economic
3. What are the problems you face in your house?

4. Do you think it is suitable for the type of climatic conditions for which it is constructed?

   Yes or No
5. Are you aware of any political policies for shelter?

6. Are you aware of the materials used in your house for the door, widows, roof and floor?

7. Do you think budget affects the quality, planning and choice of materials?

   Yes or No

8. What according to you is the most popular and convenient building material?

9. Do you think that modern materials are replacing our age-old traditional styles and materials?

10. What do you think are the advantages and disadvantages of this change?

11. How do you feel about building materials like mud and alternate building materials?

12. Do you think people's needs and preferences are taken into consideration and incorporated into the design of the houses built for them?

    Yes or No

13. What do know about energy use and housing?

14. What are you your views about energy efficiency and energy conservation?

15. Do you think it should be an important consideration in design?

    Yes or No

16. What according to you would affect comfort in your home?

17. Do you have any idea about how to improve natural lighting, shading, cooling, and ventilation etc? If yes how?

18. What do you understand by sustainable shelter?

19. What according to you is the importance of sustainability in terms of attitudes and barriers?

20. Are you happy with the services and other networks provided in your area?

    Yes or No

21. Where do you prefer to live in the city or the suburbs and why?

22. Are you satisfied with your home conditions or would you like to make some changes? And what changes?

Appendix 2

Given below is the Questionnaire developed for the stage B case studies:

Name:

Address:

Brief introduction of my objectives for this survey

- The main objective of this questionnaire is to collect information on the quality of urban shelter in accordance with user needs
- This survey is also being carried out to gauge the awareness of the builders and architects regarding the use of cost effective and energy intensive construction techniques and building materials in order to achieve comfort.
- Another important part of this survey is to determine the satisfaction level of the inhabitants and identify problems and constraints:
  - Based on the this Survey
  - According to the architects and builders
  - Based on Government records

Instructions:

- Please answer every question, or put a question mark against any that you cannot answer
- Please note that most questions have more than one part
- Most questions can be completed by ticking the appropriate boxes in the table
- Unless otherwise stated please answer by ticking only one box, that is most appropriate to you

- If you have any questions or queries, you can call me at: 3793977

For Example:

To what extent do you agree or disagree with the following statement:

I believe that higher standards of living has increased the consumption of electricity

Strongly Agree Strongly Disagree

1	2	3	4	5
✓				

If you do not think so then you might tick the last box, as shown

About your Home

1) What is the description of your house?

Detached House	Low-rise Flat	High-rise Flat	Other
☐	☐	☐	☐

2) What were the priorities for the choice of your home?

- ☐ Locational Advantages
- ☐ Cost
- ☐ Comfort
- ☐ Good external elevation
- ☐ Other

3) What were the reasons for your choice of location for a house?

- ☐ Near Friends/ Family
- ☐ Near Shops
- ☐ Near other facilities like schools and hospitals
- ☐ Near work place
- ☐ Greenery
- ☐ Less congestion
- ☐ Accessibility (good transport system)

4) Do you think that budget affects the cost of construction, planning and the choice of building materials?

Yes/ No

5) What proportion of your income do you and your family spend on your house?

< 10%	10-15%	Half	More than half

6) On what do you spend mostly?

Heating/Cooling ☐ Maintenance ☐

7) Do you think your home investment is a good value for your money?

Yes/ No

8) In which room are you most uncomfortable in your house?

- ☐ Bedroom
- ☐ Living Room
- ☐ Dining Room
- ☐ Kitchen
- ☐ Bathroom
- ☐ Other

9) Why?

- ☐ Lack of Space
- ☐ Too hot/Too cold
- ☐ Stuffiness
- ☐ Other

10) What do you look for in a house? (Tick all that apply)

Quality	☐
Comfort	☐
Privacy	☐
Space	☐
House Design	☐
Parking	☐
Communal Playground	☐
Energy Efficiency	☐
Low Maintenance	☐
Natural Light in the House	☐
Traditional Materials	☐
Modern Materials	☐
Cost Effective	☐
Value for money	☐
Close to Job	☐
Close to other Facilities, like shops and school	☐

11) What according to you is wrong in the construction system of your house?

- ☐ Planning
- ☐ Thermal comfort
- ☐ Services
- ☐ Maintenance
- ☐ High cost of conditioning
- ☐ Over-crowding
- ☐ Location

12) What type of housing did you live in before this one?

- ☐ Low-rise
- ☐ High-rise
- ☐ Detached
- ☐ Bungalow

13) How often are any of the following a problem in your house? (Tick all that apply)

Never				Very Often
1	2	3	4	5

					Too hot in summer
					Too cold in winter
					Lack of privacy
					Lack of space
					Stuffiness
					Noise from outside
					Noise from other rooms
					The standard of construction
					Security
					Dampness
					High maintenance cost

14) How pleasant a place do you find your house to live in?

Very Unpleasant	Quite Un-pleasant	Neither Pleasant nor Unpleasant	Quite Pleasant	Very Pleasant

15) Have you ever lived in a traditional building?

Yes/ No

16) If yes what is the difference between the traditional building and your present home?

Less				More
1	2	3	4	5

					Comfort
					Space
					Privacy
					Security
					Quality
					Building Materials
					Cost of building
					Maintenance Cost

17) What are the materials used in your present home?

Brick	Concrete	Other (please specify)

18) Are you happy with the building materials used?

Yes/ No

19) If not, why? (Tick all that apply)

	Bad Quality
	Indoor temperature not comfortable
	Dampness
	Noise
	Appearance
	Maintenance cost high
	High cost of building materials

20) Do you have air conditioning in your home?

Yes/ No

21) How often do you use it?

All Day	At Night	Frequently	Occasionally

22) What kind of cooling system do you have in your home?

Fan	Cooler	Air-Conditioner	Other?

23) In comparison to your last home, do you have cooling or heating on in the house:

A small proportion of the year | About the same | A greater proportion of the year

24) If the indoor air temperature is improved with the help of good planning, ventilation and use of climatically suitable materials, would lessen the use of conditioners?

Yes/ No

25) Are you happy with the services and other networks provided?

Yes/ No

26) What is the most suitable housing for you and your family?

Detached House | Low-Rise Flat | High-Rise Flat

27) Do you think that people's needs and preferences are taken into consideration and incorporated in the planning and design of the house built for them?

Yes/ No

28) Are your satisfied with the comfort and quality of your home?

Yes/No

29) If not what correction would you like to make?

30) What are the good points about your home?

31) On account of the environment of your home- has your general health improved or deteriorated?

Appendix 3

Set A interview questions for Stage A case Study

1. How many members are there in your family?

Case Study 1: Average of 4 to 5 family members in one flat.

Case Study 2: High density living with an average of 6+ members in one unit.

Case Study 3: High density living with an average of 6+ members in one unit.

2. Is shelter affordable to you without external help?

Case Study 1: All respondents said no, put in their life savings plus loans and paid in instalments.

Case Study 2: All respondent said shelter would not be affordable without assistance. They had to put in savings along with loans from bank and relatives in addition to received assistance from Costford.

Case Study 3: All respondents said no, also felt land was expensive along with building materials and therefore could only build gradually one room at a time, five mentioned about the NOC fees which needed to be paid to CIDCO to make construct additional room which was about Rupees 64,000 (£1=80 Rupees approx) which is very high for a low income family to afford and future construction would need another NOC fees of around 20,000 to 30,000 Rupees, along that additional most respondents said they spent on an average of 5 to 6 lakh Rupees to build around 4 room units. Loans, plus office loans, plus money borrowed from relatives have been used to invest to their units. Some respondents also mentioned that they bought their plots from another person. Three respondents commented on the difference in house prices between Greater Mumbai and New Mumbai. They felt that shelter units were more affordable in New Mumbai as compared to the costs in Greater Mumbai as they could afford a decent unit for around 5 lakhs, which would be impossible in Greater Mumbai. One respondent felt it was a good deal since Greater Mumbai was only around 40 Km away from New Mumbai and easily accessible by train. However 5 respondents still felt that the costs were still not very affordable for a large number of LIG households and could be lesser if the NOC fees were to be reduced as every time they built additional units they has to pay a high fees making the expenditures higher by thousands.

3. How do you travel to work?

Case Study 1: All the interview respondents owned a car and drove to work.

Case Study 3: Mostly by bus and cycles.

Case Study 3: The respondents used the bus and rail services to work, and Vashi was only half an hour away from Greater Mumbai SC station by train for those who worked there.

4. Is your house a comfortable space to live in?

Case Study 1: All respondents said yes.

Case Study 2: All respondents said yes.

Case Study 3: All the site and services respondents didn't have any complains on their units but the public flat respondents expressed discontentment.

5. Do you use fans, air conditioners and heaters?

Case Study 1: All respondents said yes to use of fans all day. A larger percentage of the respondents used air-conditioners frequently during summer. Most respondents did not use electric heaters as frequently used and people resort to wearing more layers to keep warm indoors and outdoors.

Case Study 2: All respondents said no to air-conditioners, some owned a table fan.

Case Study 3: In response to the question on what they mechanical systems they used to improve indoor conditions, all respondents said they depended on fans and four respondents said they used air-conditioners occasionally.

6. Are you happy with your house?

Case Study 1: Most respondents gave comments like yes to an extent.

Case Study 2: All respondents said yes.

Case Study 3: All respondents said yes.

7. Any complaints?

Case Study 1: Comments from the ten respondents were mainly on regular power failures, too hot sometimes, inadequacy of space, parking space not adequate, noise pollution, site too close to road, so noise, dust and smoke pollution, space not adequate and lack of security due to rise in crime in the locality and few cases of burglary and even murder.

Case Study 2: Most respondents were satisfied except for space and services, three complained of dust sticking to the exposed walls and few complained on mosquitoes and entering through the grilled windows.

Case Study 3: Comments from the site and services respondents were mainly high cost of services, NOC fees very high, and metre readings not accurate. Among public flat resident respondents, there were complaints on the deteriorating quality of their structures.

8. Are you satisfied with the materials used?

Case Study 1: Most respondents said yes.

Case Study 2: Most respondents said yes.

Case Study 3: Most respondents said yes, however the site and services respondents expressed discontentment over the quality of the materials used complaining of dampness and leakage.

9. Do you think the total investment cost towards your house will be higher or lower than 10 years of running cost?

Case Study 1: All respondents felt it would be higher, most said this was mainly due to the location in the city cost was higher than in suburbs, high cost of building materials and cost of construction.

Case Study 2: All respondent felt it would be higher due to high cost of land and building materials and their minimum use of electricity.

Case Study 3: All respondents felt it would be higher due to high cost of material, land and high quotation given by the builders employed and five respondents mentioned about the additional NOC fees.

10. Do you know if any new alternative materials used in your house?

Case Study 1: All respondents said no, only brick and concrete, one respondent said traditional materials were becoming more expensive than conventional materials as the knowledge to make then is dying, one respondent said that conventional materials and mechanical systems were preferred as they gave quick results and required less labour, one said conventional materials are time tested and implemented.

Case Study 2: All respondents said no.

Case Study 3: All respondents said no and preferred conventional building materials like brick and concrete, one respondent said he went an exhibition on new materials and collected pamphlets for use in the interiors of his house.

11. Do you recycle waste?

Case Study 1: Yes old newspapers, plastic waste, bottles and other household waste to kabariwalas in exchange for money of other household goods like plastic buckets and pans.

Case Study 2: Yes to local rag collectors who come by regularly shouting and they can be called in to sell old household waste.

Case Study 3: Yes to local rag pickers in exchange for money and other goods.

12. Have you participated in either the planning or construction of your house?

Case Study 1: All respondents said no.

Case Study 2: All respondents said yes.

Case Study 3: All respondents said yes and that their units were built according to their needs and economic conditions.

13. Are you aware of any present Government schemes on housing being implemented?

Case Study 1: Most respondents said no, one said yes but never achieved.

Case Study 2: All respondents said no.

Case Study 3: All respondents said no.

14. Would you like any changes in your shelter?

Case Study 1: Most respondents said more space, one said modification in order to suit his present day needs as the units was around 25 years old.

Case Study 2: All the respondents said more space with comments like more children need for bigger space, growing family needs.

Case Study 3: Most respondents said more space and better services, more openings for ventilation. According to one respondents, he lived in Greater Mumbai high rise flat before, which was built after demolishing an existing cottage, he said that they faced problems of drainage and other services as the load of 50 families were living in a 5 family load and therefore he moved to New Mumbai where is got his own plot.

Appendix 4

Set B interview questions

1. How many members are there in your family?

Case Study 1: Average of 4 to 5 family members in one flat.

Case Study 2: High density living with an average of 6+ members in one unit.

2. How do you feel about indoor comfort?

Case Study 1: Most respondents said ok, some comments were: winters are ok but summers are too hot, in summer it's uncomfortable and fans and air-conditioners are used.

Case Study 2: Most of the respondents complained of summer heat and discomfort, some mentioned of problems during monsoons and less space.

3. What do you think about the quality of your shelter?

Case Study 1: Most respondents felt the quality was good, ok and all the respondents has no particular complaints except for one respondents who felt the construction was not up-to the mark and narrated an incident about his neighbour drilling a nail his side of the shared wall and the bricks fell into his side of the flat leaving a hole on the wall.

Case Study 2: According to some respondents, the quality was ok as their units were secure, according to some they would prefer a more permanent units made of bricks and cement.

4. Are you aware of passive systems used?

Case Study 1: Most respondents were aware of natural lighting and solar power, some felt that nothing much is done on this side of the stream, some respondent talked about shading, use of ample windows, open terraces, balconies and lawns, use of good design, tapping solar wind energy.

Case Study 2: Most respondents said they could not afford air-conditions, only fans. Most families said they slept in the terraces in summer.

5. Do you recycle?

Case Study 1: All the respondents said that rag collectors' come by often and can be called to collect household waste in exchange for money mostly.

Case Study 2: Most respondents said yes, it provided households with money, according to some of the respondents; some households living in this development were involved in recycling old good and selling them, also the houses they built were mainly old households and construction waste materials, some places old salvaged materials from construction sites like old bricks and wood were sold for second hand prices.

6. What are your household energy costs?

Case Study 1: The average spend on electricity was rupees 3000 per (£ 37.5) month. Case Study 2: The households spend on average rupees 200 per month, (£1.87) some respondents admitted to tapping electricity for free from the main line.

7. How much have you spend on your home investment?

Case Study 1: The unit's range from rupees 3000000 and above (£37500), and all the respondents said they'd spent 3000000 plus on their units due to refurbishments and changes.

Case Study 2: Rupees 10,000 deposit for a piece of land of 10X18 feet or 10X25 feet, some households spent nothing more as their units were made of plastic sheets which are household and factory waste, some respondents had their house units made of bricks, which cost rupees 2 per brick and wooden planks and cement for plaster and spent from rupees 20,000 to 40,000 in total and made additional units based on needs.

8. Did you take any loans?

Case Study 1: Most respondents aid since the flats were on instalment schemes, it was more affordable, some respondents said they'd taken loans as well.

Case Study 2: The respondents said no

9. Any other problems you would like to talk about?

Case Study 1:Most respondents said no, some complained of noise and pollution.

Case Study 2: Most respondents complained of government planning to demolish their units and relocation as they were settled in this development and worked in the area. Some respondents talked about all the informal businesses they had set up and invested money into. Another respondents, a graduate who has been living here since 1980, has a watch repairing shop and a phone booth in his house facing the street. According to one respondents having the workplace in the house, cuts down expenses of rent and travelling. One respondent said she owned a shop, which helped her support the family and relocation would take that away. According to another respondent, their units are being demolished every now and then and every time, they have to rebuilt once the authorities leave.

10. Anything you would like to change?

Case Study 1: Most respondents said no, NA, left it blank, some said a few changes to suit present day needs, some felt more space provisions.

Case Study 2: More permanent units, security of tenure, more space.

Appendix 5

Set C interview questions for architects and planners concerned with the developments

1. What are the main concerns of urban shelter today?

Case Study 1 DDA Official: Rapid population growth thus inadequate shelter production especially for the urban and rural poor along with land and resource and civic infrastructure constraints.

Case Study 2 Costford Member: Providing cost-effective quality shelter for the poor.

Case Study 3 CIDCO Official 1: Providing affordable shelter for the masses and land resource.

CIDCO Official 2: Cost and limited recourses to provide affordable shelter for all, especially the economically weaker section that cannot afford even the site and services plots.

2. How are the shelter issues being dealt with?

Case Study 1 DDA Official: DDA has adopted ways like using fixed blocks and replicating mass housing in order to deal with shelter needs for the poor. DDA along with other public sectors bodies like HUDCO have been working together to deal with shelter needs for not only Delhi but all over the country. 20-point programs have been set up for housing and slum development, which provides assistance and funds. HUDCO provides loans to poor families up to 15%. Government polices also focus on the poor environment of the urban slums and have schemes to provide basic services like drainage, public toilets and streetlights. Rural housing schemes also provide financial assistance like of around Rupees 20,000 to 22,000 per unit to LIG rural families and around 10,000 for up gradation.

Case Study 2 Costford Member: By Costford mainly through research on appropriate technologies and their application especially in the area of cost-effective technologies for the LIG households.

Case Study 3 CIDCO Official 1: By producing affordable shelter which caters to all sections of the community and CIDCO has adopted a lot of ways to deal with providing shelter needs for the LIG, MIG and HIG and also for the NRI's who provide foreign exchange. The HIG and NRI units are sold with a surcharge, which makes up for the subsidies provided to the LIG.

CIDCO Official 2: New Mumbai is distinguishable from cities like Chandigarh and Gandhinagar because the Government financed it. Funds were raised from the sale of land, even for railways and CIDCO contributed to 66% of the cost. In large cities in India most of the social facilities are developed by charitable institution and through differential pricing system it was possible to encourage these facilities by providing cheaper land.

3. What do you think of sustainable design?

Case Study 1 DDA Official: Yes sustainable design should be given importance in domestic and commercial buildings and the National Housing and Habitat Policy has been set up in 1998 to address the issues of sustainable development, therefore DDA has used new technologies developed by HUDCO like aerated concrete blocks in some developments as these blocks are fasted to build and save time and money, also fly ash which is an industrial waste causes pollution has been made into blocks and are being used in some developments.

Case Study 2 Costford Member: Yes sustainability is very important aspects of buildings and that's why Costford builds shelter developments that are not only cost-effective but promote local economy and use locally available materials. We should promote materials

what are renewable and biodegradable, as most architects and builders even today do not think in terms of sustainability and conservation and still use standard materials and plans. Therefore attitudes and actions are not towards a sustainable development.

Case Study 3 CIDCO Official 1: Yes sustainability should be considered in shelter developments and in Navi Mumbai different types on units suitable for the three income groups have been developed: for the LIG site and services plots which has plinth and one room, for the MIG bungalow row houses each plot ground+1 which share common boundary walls and therefore save on materials and also saved street lighting and also houses of ground +3 for the MIG and saving are made on foundation and no need for lift, for the HIG luxury apartments. Most of the developments use environmental friendly material like recycled particle wood panels. New Mumbai development is also sustainable because of the wholesale acquisition of land. Vashi was acquired first because it was not possible to acquire land in other areas. In case of areas like Kalyan the municipality would have to pay heavy compensation and therefore not acquired.

CIDCO Official 2: Yes sustainability should be considered in design In order to improve buildings Cidco has adopted many new technologies in order to use the more appropriate in terms of cost, suitability and workability. The technologies adopted have been chosen for their time saving quality for example the tunnel technology which is a monolithic casting of RCC wall slab using the tunnel form technology and 30 buildings of ground+3 structures with 4 tenements per floor have been constructed in a time period of 12 months. Savings were made on foundation fillings by using marine clay, which was topped with murrum, and thus hills were saved. In 1971 polices was to discourage cars and this good bus and rail networks was adopted.

4. What are the main technology and materials used in construction today?

Case Study 1 DDA Official: Mostly brick and concrete are used however recent developments hollow concrete blocks have been adopted in New Delhi developments by DDA.

Case Study 2 Costford Member: Brick and cement, also Mangalore tiles, which are local tiles, used for roofs.

Case Study 3 CIDCO Official 1: Brick and concrete blocks were used for their insulation properties and tunnel form technologies are being used at present.

CIDCO Official 2: Brick, which comes from Kopali and Panvel. Concrete is also used, as it is easier to get. Concrete and brick are short-term expensive but long-term expensive.

Timber is incurs huge maintenance expenses in making it termite proof and it short-term cheap but long-term more expensive.

5. Have you adopted alternative technology in your development projects?

Case Study 1 DDA Official: Yes hollow concrete bricks which provides better insulation, better water proofing, construction is much faster and are standardised therefore requires a lot of standardization.

Case Study 2 Costford Member: R&D and application of alternative technologies must be given priority to in order to preserve non-renewable resources. Fillers slabs, which are either lightweight bricks or Mangalore tiles, have been used in RCC slab roofs, which save the concrete used, and reduce cost of the RCC slab by around 30 to35%. Rattrap bond has been adopted which reduces 25% of the total number of bricks and provides insulation. Leaving the walls unplastered also reduces cost, and requires no painting and incurs less maintenance cost.

Case Study 3 CIDCO Official 1:Crushed stones are used instead of sand for concrete, as sea sand is more expensive. Traditional methods are becoming scarcer as skilled labour needed is not available, as skilled labour has gone to industries like engineering industries.

CIDCO Official 2: Yes new technologies are developing fast and many new technologies have been adopted, tried and tested and the latest is tunnel technology being used in recent developments in New Panvel.

6. What about recycling building materials?

Case Study 1 DDA Official: Wood and also industrial waste has been reused in the form of building materials a good example is fly ash blocks.

Case Study 2 Costford Member: Waste Mangalore tiles can be used as fillers slab and waste in minimised during construction.

Case Study 3 CIDCO Official 1: Wood is recycled and also crushed stones are used for concrete

CIDCO Official 2: Wood is recycled into laminates

7. What about energy use in buildings?

Case Study 1 DDA Official: Yes energy use in buildings is rising because of greater dependence on air-conditioning and natural lighting, ventilation and orientation should be given more importance.

Case Study 2 Costford Member: Building material production these days are very energy intensive.

Case Study 3 CIDCO Official 1: Yes energy use should be reduced in construction and thus new technologies are being adopted in order to find more climatically suitable and efficient building technology materials.

CIDCO Official 2: New Technologies have been adopted to reduce execution costs and energy savings, also natural ventilation and lighting is maximised in CIDCO developments. As mentioned before in row housing street lighting is not needed.

8. What about passive design?

Case Study 1 DDA Official: Yes natural lighting and ventilation had been a part of passive design solution. And solar and wind power are new alternate sources of energy which will be tapped for domestic use in future.

Case Study 2 Costford Member: Yes in the shelter units built natural ventilation is taken advantage of, some units have jaali (honeycombed) work on the windows made by leaving gaps on the walls and allows air and light to pass freely.

Case Study 3 CIDCO Official 1: Natural ventilation has been optimised with better ventilation in the upper levels but more height has been given to the ground floor units, which is customary.

CIDCO Official 2: In the case of Navi Mumbai developments the window areas have been increased, orientation of the sun and wind has been taken into consideration.

9. Is user participation a part of your development plan?

Case Study 1 DDA Official: In this and most other developments the houses are mass executed and designed by the DDA architects and engineers. Basant Enclave is a good example of a MIG development executed by DDA, houses were mass executed and planned by the DDA architects and the flat were advertised after, indoor space was optimised and all spaces were designed in order to provide comfort and privacy to the households. Although these shelter schemes do not involve active public participation, they have been designed to tackle their needs and improve shelter and infrastructure conditions.

Case Study 2 Costford Member: yes Costford adopts user-friendly technologies and the user is a part of the whole process.

Case Study 3 CIDCO Official 1: During the planning stages of Navi Mumbai, surveys were conducted of households in Greater Mumbai especially on incomes and affordability scales and shelter preferences and based on that data New Mumbai developments have been planned.

CIDCO Official 2: Yes many surveys of households in Greater Mumbai have been conducted and they have been consulted time to time.

Appendix 6

Additional Questionnaire results not used in the study are as follows:
The question on difference between traditional and present house has been negated as there during analysis the question was found to be of confusion to the respondents.

In response to the question on security of their units–
MIG: 47% were content, 40% rated it fair and 13% were not content
LIG/EWS: 12% were content, 76% rated it fair and 12% were not content
HIG: 36% were content, 62% rated fair, 2% were not content

In response to the question of noise pollution-
MIG: 28% rated it as fair, 72% not content
EWS/LIG: 12% rated it fair, 88% not content
HIG: 27% rated as fair, 73% not content

In response question on problem of glare in the house-
MIG: 64% had no complains, 36% rated it as fair
EWS/LIG: 100 % had no complains
HIG: 50% rated fair, 50% felt it was a problem

In response to the question gloom in the house-
MIG: 68% had no complains, 32% rated it as fair
EWS/LIG: 100 % had complains
HIG: 2% had no complains, 96% rated fair, 2% felt it was a problem

In response to question of dampness as s problem-
MIG: 47% had no complains, 42% rated it as fair, 10% felt it was a problem
EWS/LIG: 100 % had complains
HIG: 43% had no complains, 57% rated fair

In response to cost of maintenance as high

MIG: 34% had no complains, 50% rated it as fair, 16% felt maintenance costs were high
EWS/LIG: 100 % had complains
HIG: 33% had no complains, 34% rated fair, 33% felt maintenance costs were high

In response to the question on what kind of shelter was most suitable for them and their family from the options of detached, low-rise and high-rise

MIG: 37% said detached, 63% said low-rise flat
EWS/LIG: 100% said detached house
HIG: 100% said detached house

In response to the question of how pleasant their house was to live in

MIG: 5% found it very unpleasant, 10% rated it as neither pleasant nor unpleasant, 76% rated it as pleasant, 9% rated it as very pleasant
LIG/EWS: 100% rated it as very and quite unpleasant
HIG: 50% said pleasant and 50% found it very pleasant
In response to the use of use of air-condition in the past and present

MIG: 63% said the same and 37% said more
LIG/EWS: 100% said same
HIG:57% said same, 43% said more

In response to the question on frequency of use of heating/cooling mechanical systems

MIG: 10% said all day, 45% night, 30% frequently, 15% occasionally
LIG/EWS: 100% occasionally and at night
HIG: 15% said all day, 40% night, 40% frequently, 5% occasionally

In response to the question on which room respondents felt most uncomfortable in
MIG:11% said bedroom, 6% said living room, 6% dining room, 11% said kitchen, 18% said bathroom, 48% said other and the reasons given mainly lack of 34% lack of space, 26% too hot/too cold and 26% stuffiness and 14% other
LIG/EWS: one unit's houses 100% uncomfortable due to all the reasons given
HIG: 45% said kitchen, 33% said bathroom and 11% said living room and 11% said other and the reasons given were mainly too 38% lack of space, 12% hot/too cold, 12% stuffiness and 38% other

In response to the question on general condition and well-being since moving into their house
MIG: 66% said improved, 34% said no change
EWS/LIG: 100% said no change
HIG: 78% said improved, 22% said no change