THE ECONOMIC IMPLICATIONS OF USING PLANNING GUIDELINES IN THE DESIGN OF SITES AND SERVICES PROJECTS

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Roberto Hernando Torres

School of Architecture
McGill University, Montreal
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...to my parents

ABSTRACT

Economic efficiency has traditionally been the major consideration while planning sites and services projects. But, in addition to economic considerations, equal stress needs to be given to social, cultural, and environmental factors. With these concerns in mind, the Centre for Minimum Cost Housing at McGill University has developed a set of planning guidelines for the design of sites and services projects in the Indian context. This thesis assesses the physical and economic implications of using this set of planning guidelines. Following these, four alternative layouts were prepared and evaluated through graphic and quantitative methods of analysis for their land-use and infrastructure efficiency. The study shows that the use of these planning guidelines can significantly improve land-use efficiency and the environmental quality of sites and services projects and still be at par with the economic performance of conventional planning.

RÉSUMÉ

L'efficacité économique a traditionnellement été une considération majeure lors de la conception et la planification des projects d'emplacement et de services. En plus de ces considérations économiques, on devrait accorder autant d'importance aux facteurs sociaux, culturels et environnementaux. C'est avec un tel intérêt que le 'Centre for Minimum Cost Housing' de l'Université McGill a mis de l'avant une approche alternative de planification en développant un

ensemble de recommandations pour la conception de projects d'emplacement et de services en Inde. Cette thèse évalue donc les implications physiques et économiques de ces recommandations. Après avoir développé quatre différentes alternatives de conception, deux principaux aspects ont été évalués d'une facon graphique et quantitative, soit l'utilisation du sol et l'efficacité de l'infrastructure. Cette étude démontre ainsi que l'utilisation de ces recommandations permet non seulement d'atteindre des performances économiques semblables aux projects conventionnels, mais aussi d'améliorer l'efficacité de l'utilisation du sol et les qualités environnementales des projects d'emplacement et de services.

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TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

Chapter II

Chapter V

page

Chapter VI

INTRODUCTION

Sites and services, and the upgrading of existing squatter settlements and slums, are the two most effective strategies for coping with the low-income housing shortages currently affecting large segments of the urban population in most developing countries. Widely implemented after the 1970s, sites and services programmes introduced a viable alternative to the housing policies of the 50s and 60s which provided for completed housing units. The new approach involved providing land and services to low-income families, leaving the construction of houses to the individual owners.

The planning of sites and services projects is primarily dictated by economic concerns, a key factor in the strategy's evolution. As a result, sites and services projects have achieved significant savings on overall construction costs. Despite their financial success, however, sites and services projects respond poorly to cultural and environmental factors. In fact, such projects often accomplished their economic goals, "...at the cost of environmental uniformity and by imposing severe limitations on the quality and variety of private and semi-public spaces." [1]

Planning practices in which decisions were based exclusively on economic concerns are now being re-examined. Besides incorporating economic factors, new alternative planning methods also advocate the need to consider social, cultural, and environmental factors when designing sites and services projects.

Working within this framework since 1984, staff from the Centre for Minimum Cost Housing at McGill University has been conducting research

on a series of formal and informal settlements in India. The objective of this research is to understand the physical characteristics of these settlements and to record the activities that take place in them to discern the priorities of their residents. Based on this research, the Centre has developed audiovisual training material which introduces a new set of settlement standards, or "Planning Guidelines," for the design of open spaces in low-income neighbourhoods in India. These planning guidelines respond to the lifestyle and spatial needs of low income area residents.

The objective of this thesis is to assess the physical and economic implications of using the "Planning Guidelines" in the design of sites and services projects. The study is structured around two inter-related aspects of design: physical and economic. The physical aspect examines the effects of the planning guidelines on land-use and the spatial character of the public spaces. The economic aspect evaluates the costs of infrastructure networks for various design options.

As part of the land-use analysis, areas for circulation, public open spaces, and house extensions are calculated. The infrastructure services studied are: water supply, sewage, electricity, pavement, and street lighting.

The thesis is divided into six chapters:

Chapter one deals with the concepts of sites and services projects, as well as the origins and evolution of this housing strategy. It identifies the problems with conventionally planned sites and services projects, and examines current low-income housing planning trends.

Chapter two reviews two key elements of sites and services projects: land and infrastructure.

Chapter three examines the evolution and current state of sites and services projects in India. A review of issues such as urban population growth and low-income housing policies, having a direct influence over the future of this housing approach, is also presented.

Chapter four introduces the planning guidelines and reviews the principles underlying this planning strategy.

Chapter five describes the methodology used to implement and test the neighbourhood street planning guidelines. It also explains the criteria used to generate the different design proposals and infrastructure design parameters.

Chapter six presents land-use and infrastructure efficiency data for the different neighbourhood designs under consideration. It reviews the implications of the different design options in detail. The findings of land-use and infrastructure network analyses are presented in graphic and quantitative forms.

The last section of this thesis presents the conclusions. These are organized in three levels: 1. the general planning process, 2. the findings, which are based on the analysis of the design alternatives, and 3. the recommendations regarding the use of the guidelines.

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1. Rybczynski, W., Bhatt, V., Mellin, R. "Low Income Urban Shelter Alternatives", *Open House*, vol. 8, No.3 , 1983, page 10.

CHAPTER I

SITES AND SERVICES: A LITERATURE REVIEW

This chapter presents a literature review of the planning principles behind the design of sites and services projects. It examines the origins and evolution of this housing strategy, and identifies the main problems with conventionally planned projects. The chapter concludes by examining current low-income housing planning trends.

1. THE CONCEPT BEHIND THE SITES AND SERVICES APPROACH

For the past 30 years, the "sites and services approach" has been one of the most effective tools for providing low-income housing to cope with acute and ever increasing housing shortages, and yet, "...there is little consensus about what the concept stands for precisely." [1]

Many authors on the subject acknowledge that the term "sites and services" has never been adequately defined,[2] and it is clear that the major obstacle in reaching a precise definition is the wide variety of project alternatives that come under the title.[3] Supporters of this view recognized that "...many different standards and service combinations have in different places come within the definition of the word." [4]

Some definitions of sites and services revolve around the absence or presence of various project components. An example is evident in Laquian's definition in which he states that "...sites and services projects implies the opening-up of new projects of urbanized land that are provided with services such as potable water, sewerage, roads and drainage, electricity and sometimes dwellings." [5] Similarly, Rybczynski

et al., write that "...sites and services imply the provision of plots with some level of servicing - roads, water, drainage - while the construction of the actual house is left to the owner occupier." [6]

Many other writers, and international agencies, have broadened the scope of this definition by introducing "...additional items of government involvement, such as the provision of access to employment, to loans or to construction materials." [7] These definitions not only make reference to project components but to the general objectives pursued through implementation of this housing strategy. The World Bank subscribes to this view and defines sites and services as:

> "...Subdivisions of urban land and its servicing with varying combinations and levels of public utilities and community facilities for residential and commercial use. Generally, the objective of sites and services schemes is to provide an economically accessible physical framework to a specified target low income population for their shelter and related employment needs. Sites and services schemes normally rely heavily on the efforts of the community residents with or without outside assistance, to attain their objectives." [8]

A similar approach is apparent in Peattie's definition of the term. In her view, "...the central concept of the sites and services project is a shift of focus from providing houses to providing serviced lots. The attempt is to develop a policy instrument capable of meeting the needs of families at the lower end of the income spectrum, and to harness the energies of occupants themselves in producing a low-income housing stock." [9]

The range of project options is so wide that a single definition of the term, embracing the various sites and services alternatives, is impossible. The debate on how to precisely define the scope of sites and services seems endless and arid, a fact that some writers have acknowledged. The following text, prepared by the World Bank,

summarizes this position:

> "The often posed issue of how precisely to define the sites and services concept appears as arid as that of whether the projects should be treated as a process for improving living conditions or in terms of a physical end-product of dwellings, community services, etc. Inevitably, since the term sites and services is customarily used to cover a wide variety of projects in which urban land is developed primarily for the benefit of lower income groups, it must be given a wide meaning covering both the process and the physical end-product."[10]

However, in spite of the diversity of existing definitions of sites and services, it is evident that "...practically all authors agree that its central concept is the provision of serviced lots" [11] and that "sites and services programs are all similar in that they do not provide a completed housing unit in the initial project." [12]

2. SITES AND SERVICES: EVOLUTION OF A NEW HOUSING STRATEGY.

There is no certainty regarding when and where the first sites and services programs may have appeared. Quoting Laquian, Van der Linden writes that sites and services projects "...existed before the expression had been coined, and before the World Bank decided to support this approach many countries had already made a start with them." [13]

Following the origins of the first sites and services programs, Goethert found that some of the earliest examples of sites and services projects were developed in Puerto Rico in 1935. [14] Payne, however, states that "...serviced land subdivisions, on which occupants organized the construction of their dwellings with some form of assistance and keeping some control, can be found throughout history and have even been adopted in industrialized countries such as Britain as recently as the 1920s." [15]

The first examples of government sponsored sites and services

programs date from the 1950s when local governments in Uganda, Kenya and Iraq developed rudimentary sites and services projects. [16] However, it was not until the mid sixties that the first large-scale, government sponsored sites and services projects were established. During that time, the government of Colombia promoted the development of about 12,000 lots through the "Minimum Urbanization Program." [17]

In the 1970s, sites and services programs became a common approach to the problem of low-income housing, and many governments of developing nations started to incorporate them as an integral element of their housing policies. The rapid dissemination of sites and services schemes was, to a great extent, a response to the poor housing results obtained by the governments of most developing countries through two decades of ill-conceived housing policies.

In reference to this view, Rybczynski et al. state that "...it was the consistent failure of publicly-financed and built housing to provide low-income shelter in less developed countries that required a radical shift of this view." [18] Similarly, Van der Linden indicates that:

> "The sudden growth in number of sites and services projects can be explained, ...by the failure of other, traditional approaches. During the sixties and early seventies, it became apparent that many attempts to either limit the rate of urbanization, or control squatter housing, or provide public 'low cost' housing to the urban poor had failed or - at best - had touched a fraction of the problem. Thus in a way the ground was prepared for the introduction of an alternative." [19]

Another key factor for the acceptance and rapid increase in the number of sites and services programmes was the 1972 decision by the World Bank to adopt this housing approach as the pillar of its official housing strategy. Since then, the Bank has become the primary advocate of the sites and services approach world wide. [20] The importance of this

decision is summarized by Van der Linden when he states that, without the support of the World Bank, sites and services programmes would have suffered major setbacks, if not complete rejection, in many countries.[21]

Among the various reasons for the World Bank's support of the new housing strategy, it appears that the single most important factor is that sites and services represent a low-cost alternative to the conventional approach of providing completed housing units. Besides economic considerations, planning and community development concerns are among the issues more successfully addressed by the sites and services approach. According to the World Bank, these advantages include:

> "- a greatly increased supply of building plots with urban infrastructure and services that are both economical of resources yet cannot readily be supplied on an unorganized basis;
>
> - efficient new townships within more efficient urban development patterns;
>
> - much better physical living conditions than are available in unplanned squatter settlements with greater opportunities for subsequent upgrading;
>
> - restraint of growth of unplanned squatter settlements;
>
> - increased scope for self-help construction providing dwellings at minimum cost while stimulating non monetary savings and income;
>
> - security of tenure and a basis for community development;
>
> - better general environment." [22]

It can be argued that sites and services programmes have achieved their economic goals, and there is little doubt about the economic benefit for users participating in and governments implementing this housing strategy. To this effect, Rybczynski et al. have written that "...a recent World Bank evaluation of four projects completed over a decade of urban shelter lending (54 projects in all) concludes that the

sites and services approach has been an economic success. It estimates that families building on their own can reduce costs by as much as 30 per cent compared to the conventional construction system." [23]

Other international agencies such as the United States Agency for International Development (USAID), and regional banks such as the Inter-American Development Bank and the Asian Bank, started to support the implementation of sites and services soon after the World Bank officially adopted the system. The effects of this additional support, combined with the World Bank's efforts to conduct sites and services programmes, were evident in the growing number of projects mounted during the '70s and '80s. [24]

3. THE GENESIS OF THE SITES AND SERVICES APPROACH

The conceptual framework which facilitated the evolution of sites and services projects into an alternative housing strategy was structured and developed by a small number of professionals, including John Turner, William Mangin, and Elizabeth and Anthony Leeds, who worked and studied in informal housing areas and challenged the official housing approach adopted by most developed countries during the '50s and '60s. [25] Their criticisms focused primarily on two issues: the policies adopted for the provision of low-income housing and the negative official view of slums and squatter settlements. [26]

By the early 1970s, the failure of the housing policies of the '50s and '60s was evident. First, most of the government-sponsored 'low cost' housing programmes had met with very little success: the number of housing units produced was very limited, almost always at a very high cost and in most instances unaffordable by the poor. Second, the

adoption of unrealistically high 'low-income' standards imposed severe housing constraints on the urban poor. This condition led to the rapid proliferation of squatter and illegal settlements in most cities of developing countries. Rybczynski, et al. summarize the situation as follows:

> "Most less-developed countries started in the 1950s by attacking the housing problem in what was then the approved fashion - poor people lacked housing, so it was up to the state to provide it. With a few notable exceptions such as the city states of Hong Kong and Singapore, the end of the 1960's found most less-developed countries spending a great deal of money and building very little housing. While housing ministries busied themselves with "low cost housing projects" (which usually ended up occupied by middle-income civil servants) the urban poor took matters into their own hands and established themselves on the periphery of the city (the only land available) in what became known as squatter settlements, informal housing areas, or just slums." [27]

Advocates of this new movement toward low-income housing also introduced and promoted the "...notion that squatter settlements should not be viewed as a problem but as a solution,"[28] and that "...the vast settlements surrounding major cities in developing countries were not 'rings of misery' nor 'creeping cancers', but evolving communities." [29] Payne observes that the introduction of this new philosophy "...demonstrated convincingly that the people were the best judge of what housing they needed, and in most cases they were perfectly capable of obtaining it." [30]

Within the group of supporters of the new housing movement, John F. C. Turner deserves special mention. His hypothesis that uncontrolled urban settlement is evidence of a normal urban growth process, and that slums and squatter s ctlements should not be eradicated but improved, unsettled the advocates of conventional housing. Turner's approach

views housing as a process that suits the individual needs of the family, and not as an end product. Turner underlines the fact that it is impossible for large organizations or governments to provide houses appropriate to particular needs of the families. Instead, these organizations "...would always have to standardize procedures and products and thus miss the majority of individual and changing needs and priorities." [31] As a result, Turner concludes that the primary components of the housing process must be left up to users.

Quoting Turner, Van der Linden summarizes the economic advantages of the informal housing sector over the conventional approach:

> "the bureaucratic, heteronomous system produces things of a high standard, at great cost, and of dubious value, while the autonomous system produces things of extremely varied standard, but at low cost, and of high use value. In the longer run, the productivity of centrally administered systems diminishes as it consumes capital resources, while the productivity of locally self-governing systems increases as it generates capital through the investment of income." [32]

Turner's observations regarding the benefits of autonomous housing are of interest here insofar as sites and services schemes provide the user with a greater degree of control over decision-making.

The new housing movement called for an approach more in tune with the patterns of development of the urban poor and the natural process of shelter acquisition. [33] Mayo writes that the new approach proposed a radical shift in relation to the previous housing policies of providing complete housing units. Instead, "...public programmes should capitalize on the untapped energies and resources of the poor through 'progressive development' schemes which provided housing or simply serviced lots that were affordable by low-to-moderate income households and which could be progressively upgraded over time." [34]

4. PRESENT LOW-INCOME HOUSING PLANNING TRENDS

Among the various approaches to low-income housing, current planning practices advocate the use of two basic housing strategies: the upgrading of existing squatter settlements and slums, and sites and services. The common characteristic of these two approaches is the attendant shift in planning concepts: instead of providing complete housing units, the focus is on the provision of land and infrastructure. At the same time, the process of construction and improvement of individual housing units is left to the occupants themselves, according to their own economic resources and priorities. Although these housing strategies are more in harmony with the process of housing acquisition and patterns of development of the urban poor, there is very little understanding of the planning implications and nature of the processes involved. To this effect, Payne observes that "...it is vital that the nature of the processes to be 'planned', are fully understood and the implications of 'planning' and the concepts upon which it is based are explored. Whilst the range of such concepts cover a wide spectrum, economic and social factors can be clearly identified as constituting two major basis..." [35]

In fact, the major limitation of current planning practices is the emphasis placed on economic factors, with little or no attention to socio-cultural and environmental aspects. According to Payne, this attitude "...has led to wide-spread attempts to impose inappropriate forms of 'balanced and ordered' growth." [36]

4.1 Urban Upgrading Programmes

Besides the need to provide security of land tenure, one of the

primary goals in the upgrading of slums and squatter settlements is to provide infrastructure services such as water, sewerage, and electricity. To achieve this goal, and given the unplanned form of growth of these settlements, most urban upgrading programmes almost invariably include the organization and rationalization of the settlement plan. The objective is to lay out the infrastructure services in a cost-effective way, following a grid pattern of streets and footpaths. According to Laquian, this pattern of development was used for a series of projects mounted in the Philippines through a process called 'reblocking', which involves the removal of up to 50 per cent of the structures. [37]

The above example serves to illustrate how, under the present planning principles, economic considerations dictate the criteria to be followed in the upgrading of slums and squatter settlements, where large numbers of families are relocated with complete disregard for the settlement's fabric. Mellin, however, observes that effective implementation of this approach requires acknowledging "...that installing services in existing settlements with intricate village-type layouts is difficult and costly, and that compensation and relocation for at least some residents is almost inevitable." [38]

4.2 Sites and Services Programmes

The planning and development of sites and services projects has also been primarily based on economic considerations. To this effect, Rybczynski et al. observe how present planning methods stress economic efficiency in site layout by optimizing variables such as plot ratios and road widths. These planning approaches, however, have been

unsuccessful in responding to cultural and environmental considerations.[39] In fact, the current planning framework for the design of sites and services projects is characterized by the use of two sets of closely-related considerations: (a) the economic and organizational aspects of the programmes, and (b) the physical planning aspects of the projects. The basic concepts behind each of these two components are explained below.

4.2.1 Economic and Organizational Considerations

By the very nature of this approach, economic and organizational considerations have always been, and will always be, a fundamental aspect in the design of sites and services programmes. During the mid-seventies, the World Bank structured a strategy which formally introduced most of the basic economic principles required to develop sites and services projects. According to Mayo, the main postulate upon which the strategy was based was "...succinctly set out by the Director of the World Bank Urban Projects Department who stated that: ...affordability is the key to cost recovery, and cost recovery is the key to replicability." [40] The importance of this statement lies in the fact that affordability is still the essential element in any project. However, it is important to note that all the planning parameters introduced by the World Bank derived exclusively from economic considerations. These planning guidelines fell into three main categories:

> "Project design which should be closely related to income groups chosen and involves problems of scale, scope (or coverage), standards, location and employment and self-help aspects;
>
> Project financing which involves not only the division of

> costs between occupants and public authorities but also a range of subsidiary questions including direct and indirect cross-subsidization between income groups;
>
> Project organization which covers the roles of authorities, private enterprises and community groups; land acquisition; regulation on land, construction and other activities; and the management of occupation and selection, revenue collection, sales and eviction." [41]

In the detailed description of its strategy, the Bank tacitly recognizes the poor environmental quality of the projects being produced. The Bank briefly refers to this problem which it defines in terms of 'control of aesthetics'.

> Control of aesthetics standards appears to be generally preferable through indirect methods rather than through detailed specifications or dwelling construction. The organization of provision of building materials and technical assistance in self-help construction can provide the basis for limiting building excesses while avoiding the monotony of standardization of dwellings. The street layout, design and placement of public service buildings in the area and the provision of trees for planting by community groups can all help to produce attractive surroundings. Monotony may also be relieved by the careful placing of commercial and small industrial establishments within the project area." [42]

Goethert states that the concern for project implementation issues such as administration and management, combined with the concerns for economic issues such as cost recovery and affordability, became the key considerations in all sites and services projects. In his view, "physical planning has tended to be less important and largely accepted without question. This neglect has resulted in ill-conceived plans which locked in developments to continued difficulties." [43]

4.2.2 Physical Planning Considerations

One of the most common characteristics in the design of sites and services projects is the use of grid plans. Its wide acceptance among

architects and planners results from its clear advantages over other planning approaches: the grid plan "...rationalizes both circulation and infrastructure, it can be easily and quickly laid out on the site and it imposes a relatively limited number of decisions on the planner. Its main advantage, however, is the fact that it is an approach which can be applied to extremely large sites and is capable of seemingly infinite expansion." [44]

Despite the fact that grid plans have long been used as an urban planning strategy, it was not until the 1970s that Horacio Caminos and Reinhard Goethert developed an analytical model which definitively established its use in sites and services projects. In the work developed by Goethert and Caminos, "...the grid represents a matrix within which a number of variables can be manipulated: the size and proportions of the plot, the length of the blocks and the width of the streets." [45] The Goethert/Caminos model "...is one of the initial attempts to systematically analyze the inter-relationship between the planning and design parameters and the cost parameters in an urban layout ." [46] The model provides "...some indication about the sensitivity of the landuse parameters and utility-cost parameters to the plot size and plot ratio." [47]

Rybczynski indicates that although the grid offers major advantages in terms of infrastructure costs, its greatest disadvantage is the fact that it responds primarily to economic concerns while largely ignoring socio cultural aspects:

> "The main limitation of the grid in area planning lies in the fact that it is a device whose aims are almost solely economic. The major concern is to manipulate plot layout and infrastructure in order to achieve the lowest investment cost per user. The point is not that the methodology as it stands is mistaken in stressing

> economic factors, but rather that it does not provide a ready means of incorporating non-economic environmental considerations. As a result, it is possible for a site and services project to be considered a financial "success" in spite of the fact that it may be an environmental failure. The inability of the grid planning approach to come to grips with non-economic factors is its greatest drawback." [48]

Payne also criticizes the indiscriminate use of the grid plan in low-income housing projects given the restrictions it places on the active and effective use of public open spaces by individuals. To this effect, he observes that "the somewhat rigid grid iron forms ...do have the major advantage of providing easy access for motor vehicles and also for the layout of public services. They do not however, facilitate the richer, more intensive use of urban space observed in (informal) settlements." [49]

Rybczynski observes that "the difficulty of adapting the grid to different cultures and ways of life is evident if one examines recent site and services projects in various locations. In Kenya, El Salvador and India the same mind-numbing grids show the same disregard for local traditions." [50]

The importance given to the correlation of economic variables and the physical aspects of planning in order to minimize overall project costs peaked with the development of the Bertaud model, a mathematical model for the analysis of low-income housing alternatives. Developed in the 1970s by Alain Bertaud, and coauthored by James O. Wright, and Marie-Agnes Bertaud, the model was prepared by PADCO with the support of the World Bank. Writing on the reasons that induced the Bank to encourage the development of the model, Churchill observes that, for a long time, a need was felt "...for a more general tool which would directly relate the determinants of the expenditure affordable to design and unit

costs." [51] Through this model, the planner can analyze the "...trade-offs between individual components such as the relationships between sizes of plots and levels of services that can be afforded." [52]

The model has been structured around two major components. "The first, known as the 'affordability submodel', enables a planner to see the cost implications of a large number of alternative land use patterns, infrastructure standards, and pricing options in a given project. It shows the effects of different options on the affordability of the project to selected income groups and to the development agency."[53] The second component, the 'Detailed Land Use and Infrastructure Costing and Design Submodel', known as 'code 80', allows planners to design a detailed site plan. [54]

Van der Linden is very critical of how the Bertaud's model is used and sees it as "a typical example of the World Bank attempts to find 'appropriate matches'." [55] In his analysis of the model, he acknowledges that its utility cannot be denied, given that "...it facilitates a quick calculation of the cost impacts of different project variables such as plot sizes, items of the infrastructure and payment conditions." [56] However, in the following material, he criticizes the model's inherent assumption about relating project variables, such as the monthly income, to the monthly payments that the households are supposed to afford.

> "Not only is a question mark in place behind the rather superficial assertion that the monthly payment that is affordable 'can be usually derived from household income and expenditure data ...available in most countries'. More importantly, income data, even if they can be found and if they are reliable, are a poor indicator of what households can and want to invest in housing." [57]

Rybczynski differs from this position, and on the contrary, maintains that it is possible to calculate affordable standards and

arrive at an optimum theoretical layout on the basis of disposable income. [58]

One of the major concerns regarding the Bertaud model is its potentially negative impact on project design if used exclusively to achieve cost effective layouts. The World Bank recognizes the risks involved in its indiscriminate use and states that "the danger is that technicians or decision makers may become too enamoured with the simple model and try to make solutions 'affordable' without checking whether they are technically possible or the most desirable alternative from a socio-economic viewpoint." [59]

During the late 1970s, in India, the Housing and Urban Development Corporation (HUDCO), a public sector techno-financial institution which finances housing and urban development programmes and undertakes consultancy and research in low-cost housing projects in that country, developed a new mathematical model for the analysis of low-income housing alternatives. The rationale for the development of the model was simple: according to HUDCO, the conventional design process is slow and inflexible. Through this process "...individual site layouts, infrastructure designs, building designs, quantities and cost estimates are prepared to assess the cost-effectiveness of design alternatives..."[60] However, this is a time-consuming process which does not provide a comprehensive view of the problem as only a limited number of design options can be assessed in this way. HUDCO further indicates that these characteristics, inherent in conventional design practice, required "...a new methodology for analysis and design of shelter with increased speed and flexibility and for assessing the housing and urban development standards and practices keeping in view the needs, the

paying capacity, and priority given by the people for whom these are provided..." [61]

Influenced by the principles developed by Caminos and Goethert in the book Urbanization Primer, and those present in the model prepared by Alain Bertaud, HUDCO developed a model in which closely linked land-use and cost parameters to produce as many types of physical design options as possible. The model helps planners and engineers understand the cost implications of the different project layouts possible at a given site while maintaining identical physical parameters in terms of area, design standards and engineering specifications. It also enables the planner to "...arrive at the most economical and desirable solution in a particular case." [62]

The model evolved with the vast experience that HUDCO accumulated during the 1970s when it mounted nearly 2,000 projects throughout India. From these projects, HUDCO created a series of standard planning modules, standard utility network components and a number of typologies for dwelling units which were later used to correlate physical design and cost parameters through a series of mathematical models and computer programs. It is important to point out that in the HUDCO model each mathematical model and each computer program relates to a specific set of standard modules and dwelling typologies. [63]

Through the use of these models, it is possible to associate decisions covering "...affordability, land sub-division, utility network and dwelling superstructure so as to define the shelter in all its physical and financial dimensions. These models could be used to arrive quickly at the desired solution for each component by an iterative process ultimately leading to a complete project design including layout

and building designs." [64] The HUDCO model is organized around two substructures: the first helps to design low-cost housing within a given cost. This substructure, called 'A', is mainly used as an instrument to design affordable shelter projects. The second helps to identify the cost of shelter of a given design. This substructure, called 'B', is used for project analysis and appraisal.

As in the Bertaud model, the major disadvantage of the HUDCO model is that its aims are primarily economic and that architects and planners tend to use it as a tool to obtain cost-effective layouts regardless of social and cultural factors.

4.2.3 Present Planning Trends

Existing planning trends, where decisions are chiefly based on economic concerns, are now being reassessed. According to Payne, traditional planning methods have been unsuccessful in dealing with socio-cultural and environmental factors in the design of low income settlements. He advocates the use of alternative planning approaches in the design of low-income housing, and writes that "...there is every reason to at least reconsider the merit of alternative planning models which extract the more positive and appropriate aspects of indigenous spatial structures and incorporate them into contemporary planning strategies." [65] He states that the development of more appropriate planning models must be based on a study of informal settlements "...which were developed to suit indigenous needs, and which enabled all social groups to contribute and benefit from urban life." [66] In his approach, Payne underlines that the objective is not merely to duplicate the spatial configurations and physical forms of informal settlements

but to recognize that the "...spatial structures which they generated, may well provide an object lesson in methods of using land and capital to achieve a socially acceptable and economically viable urban environment." [67]

In fact, most alternative planning methods are trying to develop new sets of settlement standards "...which seek to accommodate, rather than to reorganize, which respond to social needs, which recognize traditional living patterns, and which produce living environments that are not only affordable, but also culturally appropriate." [68]

One of the leading authors in this area is Christopher Alexander who, during the seventies, developed a new planning method that attempts to incorporate traditional living patterns in the design of housing projects. In The Timeless Way of Building and A Pattern Language, Alexander introduces the philosophical framework and the operating principles of a new planning theory. "According to this theory, it is possible to break down any traditional physical environment into a number of individual but associated patterns." [69] The essence of this approach is based on two assumptions: first, that "...every place is given its character by certain patterns of events that keep on happening there." [70] Second, that "these patterns of events are always interlocked with certain geometric patterns in the space." [71] Alexander observes that these patterns are the source that generate all built environments. In his view, "...each building and each town is ultimately made of these patterns in the space and out of nothing else." [72]

Alexander states that in spite of the fact that each pattern in the space has a pattern of events associated with it, the patterns of space, do not 'cause' the patterns of events and vice-versa. However, he

maintains that "...there is a fundamental inner connection between each pattern of events, and the pattern of space in which it happens. For the pattern in the space, is precisely, the precondition, the requirement, which allows the pattern of event to happen. In this sense, it plays a fundamental role in making sure that just this pattern of events keeps on repeating over and over again, throughout the space." [73]

Among the patterns he has identified, some may be considered universal, but most are unique to a particular culture. Alexander affirms that "...each neighbourhood, each building has a particular set of these patterns of events according to its prevailing culture." [74]

The patterns operate at different scales and have been classified accordingly: at the lowest level, the patterns refer to the individual person, progressing to the family, the cluster, the neighbourhood, the community, and finally to the towns. At any of these levels, the patterns can be specific, such as "...the optimal width of an open square, the maximum distance to shops, or the ideal size of a neighbourhood," or quantitative, such as: "...the identification of entrances to the communities, the effects of bus stops, or the provision of road T-junctions." [75]

The basic assumption behind the use of this methodology is that once the patterns for a particular context have been clearly identified they must be incorporated in any new environment generated within the prescribed context in order to be successful. If the patterns are not used to develop the environment, it may become sterile and disfunctional.[76]

Based on the principles developed by Alexander, new alternative planning strategies have been proposed. Some of these approaches seek

solutions that incorporate the principles of Alexander's theory and economic considerations. An example of this approach is evident in an alternative planning method developed by Rybczynski et al. In this case, the pattern language approach has been integrated with the economic analytical principles used for the assessment of sites and services projects in the Bertaud model. [77] The proposed planning model has been structured around a three step process: in step one, the basic objective "...is not to produce a physical plan but to establish the gross site area (including open space, community facilities and circulation), as well as the number and sizes of different plots, and the widths of the streets." [78] These parameters are based on the use of the Bertaud model. In the second step, it is necessary to identify all the appropriate patterns. In the case of sites and services, the majority of patterns will have to be drawn from those classified at the neighbourhood level. The methodology places special emphasis on the need to identify appropriate patterns for different cultures. The third step "...involves the synthesis of the design patterns with the affordable standards that have been developed in step one." [79] Under this planning alternative, the planner starts the design process at the neighbourhood level and progresses in two directions: (a) combining neighbourhoods to form communities; and (b) subdividing neighbourhoods into individual plots, or groups of plots. The advantage of this approach is that it avoids the traditional grid design process: first the plot, then the block, and finally the neighbourhood which ultimately produces a rigid grid. In this model, "while neighbourhoods may well be organized within a large-scale grid of major roads, they are not simply 'blocks', but rather autonomous social units." [80]

The Centre for Minimum Cost Housing at McGill University in collaboration with the Vastu Shilpa Foundation of Ahmedabad has been studying a series of formal and informal settlements in the city of Indore, India, in order to understand their physical characteristics, the activities that take place in them, and the priorities of slums dwellers. The aim is to develop an alternative planning method for the design of sites and services and urban upgrading projects. This new methodology is based on of a new set of settlement standards responsive to the ways of life and spatial needs of the urban poor. The strategy of this approach is to identify a set of patterns of activities taking place in the settlements in question and correlate them to the patterns of space in which they occur.

This new planning methodology seeks to overcome some of the constraints inherent in the current approach toward the planning of sites and services, specifically in the design of streets and public open spaces. To this effect, Rybczynski observes that although "the current planning methodology of sites and services projects recognizes the distinction between house plots and circulation space,"[81] it does not deal effectively with the diversity of activities that take place in the 'street'. In fact, streets and open spaces are not only places for circulation, they accommodate work, shopping and commercial activities, and serve as places for social gatherings, domestic activities and religious ceremonies. All these aspects of land use and the spaces were they occur have been studied and classified into five major groups:

(1) neighbourhood streets;
(2) work places;
(3) small shops;
(4) trees and public spaces;
(5) house extensions.[82]

Based on this research, a set of planning guidelines for public open spaces in low-income urban housing projects has been produced. A detailed description of the guidelines, which are the focus of this thesis, is presented in chapter four.

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CHAPTER II

SITES AND SERVICES: LAND AND UTILITIES

This chapter examines the two main elements in the design of sites and services projects: land and public utilities.

1. LAND

Given that land is a primary resource, its efficient use must be considered a priority in the development and implementation of any planning framework, especially in the case of sites and services projects. Payne observes that "since land usually represents a substantial proportion of the total project costs and is universally scarce in the locations where it is most needed, it is obviously vital to put each square metre to the best possible use." [1]

One of the major obstacles in achieving efficient land use in low-income housing programs has been the adoption, by a large number of developing nations, of western planning standards. The World Bank has observed how in many developing countries the physical form of residential areas reveals "...the absence of realistic planning guidelines reflecting local conditions and needs." [2] These forms have "...generally been a function of imported, often grossly overstated norms and standards." [3] This situation has been particularly true in the case of urban upgrading and sites and services projects.

Caminos states that the adoption of unrealistically high land-use standards has led in many low income housing projects to the inefficient use of valuable land. In fact, "...one of the most common problems in urban developments is the waste of land in redundant public streets." [4]

In such cases "the consequences are colossal because they increase in geometric progression, at the larger urban scale, in terms of costs for the users as well as for the supplier." [5] Caminos illustrates this case with an example of a sites and services project where the main street was 60 m wide. Fortunately in this case, the users took over a strip of land 20 m wide located in the centre of the street, where a series of informal shops were located, thus, "...making an intelligent use of otherwise wasted land." [6]

Laquian writes about the urgent need to modify codes and bylaws that segregate land use in sites and services projects, given that the standards that have been adopted, are not only unaffordable by the urban poor, but also directly contradict the traditional ways of life of low income communities.

> "Another provisional building code provision is that specific places in an urban area should be devoted to one or two uses. Thus, residential areas should be reserved for peaceful enjoyment of home life. Allowing commerce or industry in such areas would produce safety problems; encourage noise, chemical or other type of pollution; and lower property values.
> This standard of unifunctionalism goes against normal conditions in low income communities where production, commerce, leisure, community affairs, and home-life activities all happen in the same area and often at the same time. This variety of activities is the source of vitality and dynamism that is so characteristic in low-income communities." [7]

In Payne's view, new planning regulations are beginning to facilitate the more appropriate and effective use of land in low-income communities. In fact, alternative planning policies are now starting to acknowledge the degree of efficiency with which land is used in poor communities. Activities that take place in informal settlements, which were previously barred from the design of low-income housing projects, are now being recognized and adopted in the development of new

standards. In this regard, Payne writes that a wider range of land-uses is now "...frequently permitted, including shops and workshops on house plots, and regulations restricting the provision of rooms for rent are increasingly being relaxed." [8]

In spite of the changing attitudes toward land use policies, Payne states that the extent of the modifications which have been introduced is still too limited and yet mostly determined by economic considerations. He quotes Rapoport's opinion that a higher degree of attention needs to be given to socio cultural factors which have a decisive influence over the ways in which land is used. [9]

2. UTILITIES

Besides land, the provision of infrastructure services is the second major factor directly affecting the final development costs of sites and services projects.

According to Kirke, "The design and provision of appropriate infrastructure and utility services for both sites and services and urban upgrading projects in developing countries is a relatively new and inexact science. The World Bank has only been involved in this sector for 10 years and only a few countries can claim experience of more than 20 years." [10] Kirke claims that although important progress has been made in the design of affordable and appropriate infrastructure facilities, significant problems remain in the areas of administration, and maintenance. [11]

In planning sites and services projects there are five major infrastructure components which affect the final cost and the affordability of individual plots. These are presented by Shah as

follows:

1. Circulation: "Road access facilitating access to the place of employment either by foot or by public or private transport.

2. Water: either communal or individual supply.

3. Sanitation: pit latrines, sewered aquaprivies, cesspools, septic tanks or conventional sewer facilities.

4. Storm drainage: either by natural slopes with necessary culverts or by conventional storm drains.

5. Electricity and street lighting: minimum security street lighting and access to individual electrical connection if desired by the resident." [12]

The following section reviews the main considerations for the design of each of the above infrastructure services in sites and services projects.

2.1 Access and Circulation

Circulation networks are one of the most important components of any urban layout. Besides determining patterns of vehicular and pedestrian circulation, land use, and layout subdivision, circulation networks also determine the layout of utilities such as storm water drainage, water supply, sanitation, electricity and street lighting, and pavement. The World Bank observes that once the circulation network is designed and the layout is established, it "...becomes the primary determinant of subsequent commitment in terms of factors such as land requirements, infrastructure lengths, administration, maintenance, as well as the overall performance development." [13]

2.1.1 Design criteria

In most sites and services projects, streets are strictly designed

as circulation channels. However, besides circulation, streets in low income settlements are places for social and cultural interaction where household, commercial and work activities are performed. [14] Unfortunately, most international agencies and practitioners working in the area of low income housing fail to recognize this fact. The United States Agency for International Development (USAID), indicates that "The primary objective of circulation is to provide adequate and safe means of vehicular and pedestrian circulation." [15] Similarly, the World Bank defines circulation as the "...areas of land devoted to providing pedestrian and vehicular circulation: a road network for access, distribution and collection." [16] The notion that streets are places only for circulation is the major limitation present in these definitions.

Design considerations regarding circulation are commonly grouped around the following three areas: 1. level of servicing, 2. design standards, and 3. costs.

2.1.1.1 Level of Servicing: the initial level of servicing, or standard of construction, for circulation in sites and services projects is primarily determined by economic considerations such as the community's capacity to pay and the financial resources available. However, irrespective of its total cost, the common approach toward the design of circulation networks is to minimize the initial investment required for the provision of the service, thus, making space for future improvements without the need to duplicate or replace existing installations. This approach requires that a minimum and a standard level of servicing be considered. [17]

In Kirke's view, "the minimum level of service in the provision of

on-site roads and footpaths should relate primarily to the provision of reasonable access to all buildings for pedestrians. Paths or walkways provided for this purpose should be well compacted, not subject to flooding during regularly occurring wet periods and, in dry areas should be provided with at least a seal coat which will keep down the dust." [18] According to USAID the minimum level of service for circulation consists "...in the basic treatment of the soil to provide a wearing surface for circulation and drainage, and to minimize erosion, dust, mud, and maintenance. When possible, this treatment will provide a subgrade for future surfacing or paving." [19]

The standard level of service for circulation, on the other hand, consists "...in the improvement of the minimum level to the level established by the local codes in terms of traffic load and bearing capacity." [20]

2.1.1.2 Design Standards: the design and construction of streets in planned settlements in developing countries has been characterized by the use of conventional standards which are commonly based on European codes. [21] These standards usually disregard the type and frequency of traffic, the population densities, and the social, household and commercial activities that take place in low-income neighbourhood streets. [22] Besides being inappropriate in relation to the real needs of the probable beneficiaries, these standards are usually unaffordable.

The use of such standards commonly lead to the design of streets which tend to be extremely wide, considering the size and frequency of vehicular traffic. [23] Rybczynski observes that "in planned low income settlements, where plot areas can be as small as 25 square meters, wide

access streets can result in disproportionately large portions of the site being used for circulation, as compared to plots, with consequently higher land development costs." [24]

In planned housing projects, streets are usually classified in relation to the modes of circulation. Under this framework, the user and the relative domination of either pedestrians, vehicles or both, determine the physical characteristics of the street. [25] The material which follows reviews the main design considerations which are being observed by international agencies and practitioners in the design of pedestrian and vehicular streets in sites and services projects.

Pedestrian streets: Caminos writes that this type of street "...serves primarily for pedestrian access to interior lots, and communal parking facilities and secondarily for limited and controlled access of service and emergency vehicles such as fire trucks, ambulances, police patrols, etc." [26] USAID states that the minimum width of pedestrian streets should be determined according to the intensity of use:

"1.50 m inside residential areas;
1.70 m on local streets;
2.00 m general, for people passing;
2.40 m beside vehicular parking;
3.00 m beside community or commercial facilities." [27]

Kirke supports this view and states that the width of pedestrian streets should vary in relation to the density of anticipated use. He, however, does not go as far as to recommend the use of any predetermined width standards, advocating only the need to observe a minimum street width of at least 1.5 m irrespective of its situation. [28]

Caminos, on the other hand, proposes an average pedestrian street

width of 3 to 4 m. with a maximum acceptable grade of 80%. [29]

Pedestrian\vehicular streets: design considerations for this type of streets are usually determined in relation to the width of circulation right-of-ways (ROWs). As shown if figure No.1, circulation ROWs consist of: " (1) carriage ways (vehicular circulation and parking lanes); (2) walkways; and (3) buffer zones (median strips, planting areas, etc. most appropriate in arteries and express ways)." [30]

USAID suggests that the width of the ROWs in sites and services projects should be determined on the basis of projected traffic volume, modes of travel and desired speeds. The agency also states that the initial level of servicing selected does not influence the width of the ROW. [31]

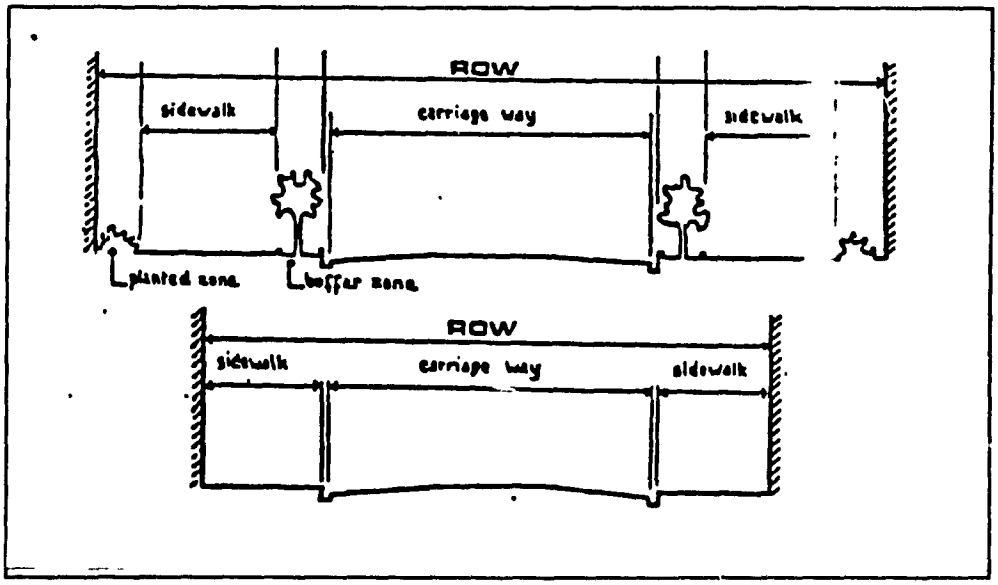

FIGURE NO.1 STREET SECTIONS, RIGHT-OF-WAYS

Based on factors such as the relative dominance of pedestrians or vehicles, speed of circulation, and vehicular capacity, Caminos proposes three types of pedestrian\vehicular streets with the following design

characteristics:

- Residential and neighbourhood streets where pedestrians dominate over vehicles. The width of these streets (ROW) ranges between 9 to 12 meters allowing vehicular speeds of up to 16 kph. The maximum acceptable grade for this type of street is of 32%. [32]

- Access and collector streets where vehicles dominate but do not control the situation. The width of these streets (ROW) ranges between 12 to 16 meters for speeds of up to 30 kph, and 18 to 22 meters for speeds of up to 40 kph. The maximum acceptable grade for this type of street is of 15%. [33]

- Intercommunity access and primary streets where vehicles strongly dominate over pedestrians. The width of these streets (ROW) ranges between 23 to 28 meters allowing speeds of up to 60 kph. The maximum acceptable grade in this case varies between 5% and 15%. [34]

Design parameters for pedestrian\vehicular streets in sites and services projects are also determined in relation to the minimum standards required for circulation. Kirke indicates that "for vehicular access, the minimum standard will generally relate to access required for emergency vehicles; in this respect no plot or dwelling should be further than 75 m from a vehicular road." [35]

USAID, however, recommends that vehicular lane widths (carriage ways) be determined on the basis of speeds of vehicular traffic:

- 2.80 to 3.20 m for speeds of up to 60 kph.
- 3.00 to 3.50 , for speeds of over 60 kph.

Additionally, USAID suggests a minimum vehicular lane width of 2.40 to 3.00 m in streets where vehicle parking is allowed. [36] The agency also recommends that for all circulation ways a minimum longitudinal slope of

1% and a grade between 2 to 4% from crown to gutter be left for drainage.[37]

Besides addressing the problem of standards for street widths, guidelines for the design of pedestrian\vehicular streets also stress the importance of carefully considering the design of street intersections. USAID writes that for the design of street intersections, three interrelated elements need to be considered:

> "- angle of intersections (not less than 60 degrees)
>
> - inner curb radius (4 m minimum for minor streets, 10 m minimum for collector streets, 12 m minimum for arterial streets)
>
> - sight distance line (45 kph, 60 m; 60 kph, 75 m; 80 kph, 100 m)." [38]

Some international agencies, such as the World Bank and USAID, also make reference to the need of incorporating cultural and environmental factors in the design of circulation networks. USAID underlines the importance of using local norms to "...help determine modes of travel, travel times for particular trips, speeds and frequency of trips." [39] In addition, the agency indicates that depending upon the context "Road design may have to consider special features such as separate lanes for bicycles, animals and animal drawn carts." [40]

2.1.1.3 Costs: Traditional planning approaches use areas of circulation as a means to determine project efficiency. The ratio between the total site area and the percentage of land taken up for access and circulation establishes a cost-efficiency indicator for project layouts. Kirke writes that in early sites and services projects this ratio was frequently over 40%. This percentage however, has been substantially decreased. Areas for circulation in new sites and

services projects in South-East Asia have been reduced to less than 20% of the total site area. [41] The World Bank suggests that "the normal range for circulation areas in a well balanced layout is 20% at lower densities to 30% at higher densities." [42] Layouts in excess of 30% evidence excessive circulation which increases public responsibility and costs. On the other hand, a layout under the 20% mark indicate insufficient circulation. [43]

According to Shah, "Roads and storm drainage cost represents on the average 30 to 40 percent of the total on-site infrastructure." [44] USAID, however, estimates that the combined cost of circulation and drainage is slightly higher: 35% to 45% of the on-site utility costs and between 10% and 15% of the total site costs. This service by itself represents the highest proportion of all utility costs. [45]

2.2 Water Supply

The principal objective of water supply is to provide access to potable water for drinking, cooking, personal hygiene and sanitary purposes. In sites and services projects, provision of water must be considered a priority and established within or at an economical distance from all plots. [46] USAID suggests that the distance between plots and water supply lines should not exceed 100 m. [47]

2.2.1 Design Criteria

There are two major considerations which need to be carefully balanced for the provision of water in sites and services projects: 1. the level of servicing standards, and 2. the selection of servicing options. Shah describes the aims of each of these two concepts as

follows:

> "The aim of servicing standards is to supply the service at a certain standard irrespective of the costs. The aim of servicing options is to minimize the initial investment that is required to provide services. This must allow future improvements without repeating or destroying existing installations. Thus the servicing options imply a postponement of the installation of services at an acceptable standard and do not mean that the servicing standards are irrevocably lowered. The concept of servicing options also recognizes the potential for incremental improvement through an efficient use of available resources." [48]

2.2.1.1 Servicing Standards: the servicing standard is primarily determined by the quantity and quality of water that is provided. The combination of these two factors, quantity and quality of water, constitutes the principal cost determinant for the on-site water supply system. [49] While control over quality of water is usually considered an external factor to a sites and services project, a factor over which the planners of a project have very limited influence, the initial and the standard levels of water consumption are exclusively internal planning considerations.

Quantities of water consumption vary from country to country and from region to region depending primarily upon technical resources and socio cultural factors. The World Bank writes that the level of water consumption mainly "...depends on the standard of living, life styles, local conditions and level of charges." [50] In fact, factors such as population densities, "...climate, standards of living, extent of water-borne sewerage, water pricing, extent of private supplies, water quality, type and scale of commercial and industrial activities, use of meters, distribution system pressure and system management" [51] determine the levels of water consumption.

In order to establish levels of water consumption it is necessary to estimate the number of litres per capita per day that are required in a given context. In this regard, the World Bank makes special reference to the study conducted by White, Bradley and White during the 1970's in low income housing projects in East Africa. As a result of their research, they were able to determine average levels of water consumption for single tap on plot connections and on-site communal stand pipes. They concluded that the average level of water consumption for low income families receiving piped water within the plot was in the order of 30 litres per capita per day. When the water had to be carried from distant sources, the rate of consumption dropped to 15 lcd. [52]

Given the impossibility of forecasting a standard level of consumption, international agencies have developed tables which list the average per capita residential use of water for different countries, as shown in figure No.2.

In the design of level of water consumption for sites and services projects, Kirke estimates that as a rule of thumb, "...the most common applicable and affordable standard of service ...is based on the delivery of around 100 litres per capita per day through a single tap outlet on each plot." [53] The World Bank, on the other hand, estimates a minimum standard of service of 20 lcd for communal stand pipes, an average of 120 lcd for single tap connections, and 180 lcd for multiple tap connections. [54]

2.2.1.2 Servicing Options: Among the various water servicing options, the four distribution systems which are most frequently used are: (a) communal wells; (b) communal stand pipes; (c) single tap

Country	Place	Estimated Daily Use per Capita in liters	Source	Year
Urban multiple taps or mixed use				
Developing nations	Several hundred	11 930	Dieterich and Henderson 1963 p 20	
Costa Rica	2 metered cities	284-388	Waters Zobel and Henderson 1959	1956
	7 unmetered cities	215		1959
	34 flat rate cities	444		
Ghana[a]	Accra High grade housing	675	Tonal 1966	1965
	Medium grade housing	185		
	Low grade housing	34		
	Substandard housing	27		
	Tema High grade	342		
	Medium grade	265		
	Low grade	108		
Greece		144	Panastassiou 1967	1965
India	Kalyani	113	Lee 1968	1964
	New Delhi	136		
Japan[b]	Osaka	620	Japan 1967	1966
	Yokohama	385		
	Tokyo	348		1966
	Kobe	328		1966
	Kyoto	317		1966
Kenya	Nairobi	90	City council report	1966
South Africa	Cape Town	144 53	Cluver n d p 29	c 1953
	Johannesburg	158	Morris 1967	1965
	Queenstown	225		
	Pretoria	239		
	Durban	243		
Taiwan	Urban pop 50 000	245	Fung 1967	
Tanzania	Dar es Salaam (all supplies)	81	Tanganyika Ministry of Communications Power, and Works 1964	1962
	Dodoma	86		
	Moshi	202		
Turkey	Greater Istanbul	108	Noyan and Senogullari 1967	1965
Uganda	Kampala	72 338	Scaff 1964 p 180	
	All municipal supplies	202	Uganda Protectorate 1960/61	
UK	Bradford	544	Skeat 1961, p 56	1958
	Tees Valley	126	ibid	1958
	Birmingham	99	ibid p 99	1958
	Glasgow	212	ibid	1959
	Liverpool	126	ibid	1958
	London	182	ibid	1959
US	All cities	227	U S Senate 1961 7	1960
	Towson Md rental	190	Johns Hopkins Report 1 2-16	1959-62
	Residence value $14 000	194		
	Residence value $19,000	214		
	Residence value $37 000	247		
Uruguay	Montevideo	178	Castagnino 1966	1964
	Punta del Este	447		
	All other towns	130-270		
Zambia	Mazabuka	27	G Marais 1966 personal communication	
	Lusaka Suburban African	13-50		
Single taps				
Guatemala	Single automatic tap systems	60	Ana 1967	1966
Paraguay	Asuncion pilot area single taps	28-49	Borjesson and Bobeda 1964 p 858	1964
Pakistan	Comilla pilot area single automatic taps	18	East Pakistan Water and Sewer Authority 1968	1968
Urban standpipes				
India	Calcutta standpipe or pump	30	Lee 1958	1964
Turkey	Greater Istanbul	15	Noyan and Senogullari 1967	1965
Uganda	Kampala	14	Scaff 1964 p 32	
Venezuela		15	Dieterich and Henderson 1963 p 28	
Rural Connected				
Republic of China	Rural area (with water systems)	60	Fung 1967	
West Germany	Rural systems	83	Schickhardt 1967	
Not connected				
Bolivia	Seven villages	10	Teller 1969	1968
Kenya	Zaina	7	Fenwick	
Nigeria	Anchau District	23 27	Nash 1946	1946
Sudan	Kordofan	9 16	FAO Land and Water Survey 1967, p 236	1967
Tanzania	26 villages in 10 districts	5-26	Warner 1969	1969

FIGURE NO.2 PER CAPITA RESIDENTIAL WATER USE IN SELECTED AREAS

connections to piped water supply; and (d) multiple tap connections to piped water supply. [55]

In planned low-income housing projects, communal wells and public stand pipes are frequently selected as the initial method for water distribution. The criteria for selection seems simple: both distribution systems, communal wells and public standpipes, present a much lower cost than conventional on-plot single tap connections. [56] According to Koenigsberger "standpipes or public fountains have much lower costs than normal piped water systems. This is due to the lower number of outlet facilities provided and to the fact that per capita demands from standpipe source are usually lower than the demand from house connections. Lower per capita consumption means smaller pipes can be used and less storage capacity is required." [57]

Kirke, on the other hand, is critical about the use of standpipes mainly due to proven lack of maintenance and dubious cost reductions. He advocates that "...where good planning results in minimum lengths of infrastructure networks, the cost of providing an on plot single tap will be little more than the cost of providing adequate standpipes."[58]

In order to minimize long term costs, Van Hyuck recommends that provision for 'ultimate individual services' be developed from the outset of the project. He believes that "...regardless of the initial method of distribution, the system itself should be laid out in anticipation of its eventual expansion to provide individual service to each plot." [59]

USAID has developed a list of technical design considerations which introduce the basic principles required for planning an efficient water supply distribution network, irrespective of the servicing option

selected. Within the list of technical guidelines for the construction of water supply distribution networks the following design principles are included:

> "- Water pipes should be located under public roads and walkways for maintenance and repair; they should be buried at least .5 m and should not be placed in the same trench with sewers; the trench should have a good foundation and be tested for leakage after installation.
>
> - Piped water principles should be laid out, if possible, with no dead ends in order to facilitate flow and eliminate stagnant water.
>
> - Choice of pipe materials should be determined by availability, cost, local regulation and the chemical composition of the soil and water.
>
> - Fire hydrants, if feasible should be located no more than 200 m (100 m preferred) from any plot." [60]

In addition to the above, the World Bank underlines the need to pay special attention to the selection of the material of the pipes, given that pipes are a major cost element of any water supply system. [61]

2.3 Sewage Disposal - Sanitation

The basic objective of sanitation systems is to provide efficient and hygienic means of disposal of both human and household waste in order to prevent pollution, disease and contamination of potable water.[62] Sanitation systems have been classified in several ways. One of the most common methods of classification has been to group the various sanitation options into on-site or households systems and off-site or community systems. [63] On-site disposal systems include the following five options: (a) pit latrines; (b) pour-flush toilets; (c) composting toilets; (d) acquaprivies; and (e) septic tanks. [64] Off-site disposal solutions include: (a) bucket latrines; (b) vaults with vacuum cart collection; (c) sewered acquaprivies; and (d) conventional sewerage

systems." [65]

2.3.1 Design Criteria

For the purpose of this thesis only conventional sewerage systems are taken into account. A brief description of their main design characteristics, and cost implications is presented below.

2.3.1.1 Conventional sewerage systems: Mara writes that "conventional sewerage is a high cost, high convenience sanitation technology. Excreta are deposited in a cistern-flush water seal toilet from where they are flushed by 10-20 litres of clean, potable water into a network of underground sewer pipes, into which is discharged all domestic sullage." [66] This system presents two major disadvantages: it uses 30 to 40% of the total domestic water consumption and it has very high operational costs. [67] USAID indicates that together with septic tanks, conventional sewerage are the more expensive sanitation systems. In the case of conventional systems the same agency also states that lesser gross densities and higher sewerage flows increase installation costs. [68]

According to USAID one of the key aspects in the design of conventional sewerage systems is the selection of appropriate slopes to provide self-cleansing velocities. The agency indicates that the minimum water velocity to retard sediment is of 0.45m/sec. Consequently, sewerage systems with minimal quantities of water demand greater slopes to maintain the minimum velocity required. [69] Conventional sewerage systems require the use of manholes for cleaning and maintenance purposes. Caminos writes that manholes need to be

"...located at all intersections, at all turns, at dead ends and at other points to anticipate future expansion." [70] The maximum spacing between manholes for small diameter pipes is of 100 meters while for large diameter pipes spacing can go up to 150 meters. [71]

The basic principle for the selection of a sanitation system is that regardless of the option to be adopted, this has to be designed in accordance with the water supply system preselected. In fact, the level of water supply, and thus of water consumption, will clearly determine the waste-water removal option to be adopted. Disregard for this rule will result in poor sanitation conditions and increase health risks.

Besides technical considerations, socio cultural factors are another important element in the criteria for selecting a sanitation system. Kirke advocates that "...the primary requirement is to make adequate, affordable, culturally acceptable and technically feasible provision for appropriate sanitation facilities." [72] The World Bank supports this view and indicates that in selecting a sanitation system its cost should not be seen as the dominant factor. The Bank writes that sometimes factors such as density, local conditions and life styles play a more important role. [73]

2.4 Storm drainage

The primary function of storm drainage is the removal of storm water runoff to prevent flooding. The lack, or inadequate provision of this system will result in flooded roads causing high material damage and higher maintenance costs. [74] It is important to highlight that in most cases a higher initial investment in storm drainage may represent, over time, a clear benefit in terms of lowering road maintenance costs

and road repairs.

2.4.1 Design Criteria

Technical guidelines for the design of storm drainage systems in sites and services projects are usually structured around a minimum and a standard level of servicing.

2.4.1.1 Minimum level of servicing: the minimum servicing level consists of a system of shallow and deep ditches discharging into natural drainage channels. Shallow ditches should be designed as part of the streets and walkways, and should avoid the use of sharp angles to facilitate their cleaning. [75] Caminos recommends that shallow ditches be designed as an integral part of the paving surface given that this type of "...design offers economy in construction, and easy maintenance, and also facilitates the utilization of the street by the people for different activities." [76] Deep ditches are considered the most inexpensive secondary collectors of rain water. Deep ditches, however, require constant maintenance. Caminos writes that although there are several models of deep ditches, the use of wide ditches with gentle slopes are usually preferable given that these facilitate cleaning and minimize accidents. He indicates that local conditions such as rainfall, topography, and soil dictate the selection of the most convenient type. [77]

2.4.1.2 Standard level of servicing: the standard level of servicing consists "...of a system of curb gutters and underground pipes discharging into either natural draining channels or a more extensive

built drainage system." [78] USAID indicates that there are three critical factors to be considered in the design of standard level storm water systems: (1) pipe sizes and material; (2) location and capacity of curb inlets; and (3) location of manholes and its spacing. The agency summarizes the key design considerations regarding each of these aspects as follows:

> "- Pipe sizes are determined by plan layout, soil type and profile, rainfall intensity, gradient and roughness coefficients; pipe material is determined by economy, availability and local regulations;
>
> - Size, number and placement of curb inlets determine how free the streets are kept of runoff water; their location next to the manholes facilitates cleaning;
>
> - Manholes should be located at intersections, bends, dead ends and generally at 100 m intervals." [79]

A factor that requires special attention in the design of storm drainage networks is the practice of combining storm water together with sewage. Kirke observes that this practice needs to be carefully assessed primarily because of the health risks involved. He writes that "in most developing cities urban sewerage networks are both limited in scale and heavily overloaded. Where any risk of surcharging exists, or can be forecast, the addition of water storm to the sewers will simply result in untreated sewerage being spread over a greater area of the city streets." [80]

USAID indicates that an additional factor of concern in the design of storm drainage networks is the topography of the site. The agency indicates that flat lands or land with a 20% slope, or higher, require special preparation for drainage, thus increasing the overall project costs. On the other hand, land with a gradient between 5% and 10% facilitates drainage. [81]

2.5 Electricity and Street Lighting

The main objective of electricity and street lighting "...is to provide power to each plot for domestic requirements, to provide illumination at night in the streets for safety and activities, and to provide power for public utilities and communications." [82] According to the World Bank, this service is potentially the most capital intensive of all infrastructure networks. [83]

Although electricity is not always considered of primary importance, at least during the first stages of a sites and services project, some level of electricity needs to be initially considered. The minimum level should include the capacity to provide street lighting to improve neighbourhood security and possibilities to develop small scale businesses or industry. Depending on the users priority and ability to pay, private connections receive a higher or a lesser priority. In latin America for example, "...priority for electricity is higher than the other utilities, and users are willing to pay a relatively high proportion of their housing costs towards a private connection, whereas many low income households in other countries prefer to use lower fuels." [84]

2.5.1 Design Criteria

In sites and services projects the electrical distribution networks are usually aerial with service drops and meters. Savings in the provision of the service are more likely to be achieved if the design standards of the networks are modified in order to reflect more realistic levels of demand. To this effect, Kirke has demonstrated how overstated electrical design standards produce a significant increase

in the total network costs.

> "It is common for agencies to assume a domestic demand of about 1.5 kW per plot. This is between three and six times greater than the actual demand for low-income households, and will, when applied to network design, dramatically increase the costs." [85]

However, when in order to reduce initial investment costs a controlled progressive development is considered, the initial minimum level of service should "...consist in the provision of high and low tension aerial cable passing next to but not connecting each plot, with street lamps at each intersection." [86] USAID observes that the adoption of this measure is highly impractical because when a minimum initial level of service is provided, "...it is very common for the people to make illegal connections to the aerial network." [87] The standard level of service, on the contrary, should consist in the provision of street lamps on each pole and the connection of each plot to the cable network.[88]

The following section presents a summary of the key technical guidelines required for the design of aerial electricity networks and street lighting.

- Caminos recommends that for secondary low-tension networks the maximum length for circuits should be of 150 meters with a voltage drop of 5 V. [89] USAID however, recommends a maximum circuit length of 200 meters with a voltage drop of 6 V. [90]

- Poles should be placed at a maximum distance of 30 to 40 meters and at all points where there is a change in cable direction. [91]

- Specifications regarding optimum pole heights recommend that for high tension cables and transformers poles should have a minimum height of 10 meters; poles for low tension cables should have a minimum height of 7 meters; poles for individual service drops should have a minimum

height of 5.4 meters. [92]

- The maximum distance between service drops should be of 30 meters. "...the possibility of linking several nearby lots to one service drop should be considered, particularly in the case of clusters and condominiums. Service drops can cross streets." [93]

- At the minimum level street lamps should be provided at all street intersections. At the standard level, street lamps should be installed at all poles, providing a minimum level of street lighting of 0.2 to 0.5 footcandles. [94]

- "Underground supply of networks of electricity are too costly for consideration in sites and services projects." [95]

- In order to reduce costs, the use of combined circuits for street lighting and for electric services should be provided. Additionally, the use of "Efficient lamps, wide spacing of poles and lamps, large lamps and high mountings directly reduce capital costs." [96]

2.6 Community Utilities and Services

Besides the above five infrastructure services, Caminos refers to a series of complementary utilities, services and facilities that need to be considered in the formulation of sites and services projects such as: "...gas, telephone, public transportation, police protection, fire protection, refuse collection, health, schools, ...and other community facilities." [97] However, these are seldom included in theoretical studies of sites and services because the extent to which any of these may affect a project vary depending upon the particular conditions of each project.

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CHAPTER III

INDIA: SITES AND SERVICES

The design of sites and services projects, as it was documented in the first chapter of this study, has been characterized by the use of conventional planning methods which primarily stress economic efficiency in site layouts. The goal has been to make plots affordable to a maximum number of people. The implementation of this planning principle in sites and services programmes all over the world, has resulted in a tendency to project standardisation regardless of the context. Sites and services projects in India are no exception.

Sites and services programmes in India "...provide plots of land for the use of the Economically Weaker Sector, with varying levels of services and amenities." [1] Project alternatives range from demarcated plots of a given plinth area with minimum infrastructure servicing options, such as communal sources of water supply and sanitary facilities, to core housing with fully serviced on plot infrastructure schemes. The level of infrastructure services and amenities provided in each case is determined by the physical and economic constraints of each project.

Sites and services projects and the upgrading of squatter settlements and slums are, and will continue to be, the most efficient housing strategies to meet the increasing low-income housing shortage despite facing difficulties in the procurement of suitable land, limited financing, and unrealistically high planning and construction standards. Over the past ten years both housing strategies have been widely used by

the Indian central government which has adopted them as the pillar of its housing policies. The trends are clear: during the sixth five year plan, 1980 - 1985, the central government incorporated for the first time the upgrading of slums and squatter settlements as part of its housing strategy. This policy decision was complemented with an effort to boost the development of serviced lots. To this effect, Sundaram writes that "...the sixth year plan envisaged an investment of Rs. 4,850 million to produce 1.6 million EWS (economically weaker sector) units in the form of developed sites." [2] However, there is very limited data about the results of this plan. The same author indicates that by the end of the fiscal year there was no information as to how the allocation was used and who benefited. [3]

During the seventh five year plan, period 1985 - 1990, the development of urban upgrading and sites and services programmes was kept as the official housing policy for the EWS. The plan directed "...the public sector to concentrate on the provision of developed sites and the provision of a fiscal and financial infrastructure to the beneficiaries for the construction of the houses." [4]

The eighth five year plan, 1990 - 1995, still continues to keep sites and services and squatter upgrading as the main housing strategies to reduce the low-income housing deficit. This plan emphasizes the need to stimulate the participation of private land owners in land subdivision programs, a model known as 'participative land development', and to expand the coverage in water supply and sanitation. The goal is to increase the percentage of land available for sites and services projects. [5]

The gradual shift in housing policies in India has originated a significant increase in the number, and scale, of sites and services projects built and under construction. Although overall statistics at the national level about the impact and reach of sites and services programmes are still very limited, available statistics for major urban centres clearly demonstrate the effectiveness of this housing strategy. Examples can be observed in the vast low-income housing programmes implemented in cities such as Madras, New Delhi, Bombay, Calcutta, and Indore among others. The following two examples help to illustrate the scale and impact of sites and services in Indian cities.

In the case of Madras, the Tamil Nadu Housing Board (TNHB), the local body responsible for constructing social housing, in association with the World Bank started to in 1977 to develop an ambitious housing programme which included the construction of large scale sites and services projects. Pugh writes that as a result of this plan alone, the total number of plots developed in the form of sites and services, between 1977 and 1984, was approximately of 157,000. [6] Since 1984, the average volume of sites and services type plots built has been estimated at 25,000 per annum. [7] This annual increase represents an additional 150,000 plots between 1984 and 1990.

Another example of the extent of sites and services can be seen in New Delhi where by the end of 1981 the official housing agency, the Delhi Development Authority (DDA), reported the development of approximately 260,000 plots in the form of sites and services and resettlement schemes. [8]

In the material which follows main factors which have had a direct

impact over the development of sites and services are reviewed.

1. URBAN POPULATION GROWTH AND ITS EFFECT ON HOUSING

The adoption of sites and services projects and the upgrading of slums and squatter settlements has been the result of the enormous pressures that have been exerted by the high rate of urban growth on urban resources such as housing, water supply, sanitation, and power. According to the 1971 census the total urban population of India was of 110 million persons. By 1981 this figure had increased to 160 million, representing 23.70 percent of the total population. This meant an urban population increase of 50 million persons over a ten year period with an average increment of 4.54% per year. [9] Projections for the 1981-1991 period estimate that India's urban population will increase by approximately 70 million people. [10] This rapid rate of urban growth has been primarily determined by two factors: the increasing level of rural urban migration and the high rate of birth.

1.1 Rural-Urban Migration

The constant influx of rural population migrating to urban areas has been mainly determined by the extremely poor living conditions in many rural areas, and the search for employment. The figures are staggering. During the 1971-1981 period the total number of rural-urban migrants was approximately of 34 million (about 68% of the total increase in urban population). [11] If the current trends of rural-urban migration remain at this level, as it is expected, during the decade of 1981-1991 urban centres will have increased their population by

approximately 47 million.

1.2 Birth Rate

The increase in India's total population due to high birth and longer life expectancy rates has also been overwhelming. According to the 1981 census the total population of India in that year stood at 685 million, with an annual growth rate of 2.4%. [12] Moderate population projections estimate that during the 1981-1991 period, the total population will have increased by 151 million, averaging a total of 836 million persons. [13] It is estimated that roughly 45% of the new births during the decade will occur in urban centres. [14]

1.3 Slum Population

This massive increase in urban population in combination with a limited housing stock, a restricted access to the land market, and a lack of economic resources to cope with the housing needs of the new population, has resulted in the steady growth of informal settlements or 'slums'. According to statistics provided by the National Buildings Organisation in New Delhi, 30 million persons, out of a total urban population of about 160 million, are now living in slums. [15]

2. SLUMS AND RESETTLEMENT PROGRAMMES

Slums in India have been traditionally seen more as a housing problem than as a housing solution. The first official policy toward slums and squatter settlements was established under the Slum Clearance/Improvement Scheme of 1956 in which the central government was

granted with necessary powers to compulsorily acquire the slum and squatter settlements areas in order to redevelop them. The aim was to demolish and replace what, in the eyes of the government was considered as unfit housing areas. [16] But in 1972 the Indian central government introduced a major change toward the policy of slum eradication. The emphasis was put on the environmental upgrading of slums through the provision of infrastructure services such as communal water supplies, sewerage, storm water drains, community baths and latrines, street lighting, and paved roads. [17] In the following material Gupta aptly summarizes the causes for the change in policy direction:

> "First, there was the wide spread resentment against the wholesale demolition of established communities that redevelopment often entailed. Second, the volume of available resources for redevelopment were inadequate to bring about the desired increase in the quality of housing stock within a reasonable period of time and to match the rate at which fit dwellings were deteriorating. Moreover, the shift in emphasis was expected to induce the owners of substandard dwellings to invest in renovating their properties. Finally, it was expected that a given quantity of resources would distribute benefits more widely if they were used for renovation work rather than devoted to redevelopment. With this shift in emphasis, explicit recognition was also given to the fact that the neighbourhood environment constitutes an important housing externality." [18]

The adoption of large scale sites and services projects in India began during the late 1950s as a result of the implementation of the resettlement programs. These early projects were designed to house the lower income classes living in slums and squatter settlements, however, the adoption of inappropriate housing policies greatly limited their success. In fact, problems related primarily to location and the use of extremely high standards made them unaffordable by the urban poor. Additionally, the adoption of high subsidies greatly limited the

potential to cover a significant segment of the population. An example of this approach can be seen in the resettlement programs implemented in New Delhi during that period. Writing on the subject, Bhatt describes how the Delhi Development Authority (DDA) developed sites and services projects with "...rather generous design standards - 72 sq. m plots with a built-up plinth, individual toilets and water connection on the plot and sometimes a small core structure. In addition, the beneficiaries were entitled to a Rs. 1000 (US 1.00=Rs. 12) grant for the super structure construction." [19] Most of the sites and services projects built under resettlements programs were developed in the outskirts of the cities where employment opportunities were almost non-existent, transportation was expensive and inefficient, and where the provision of infrastructure services was difficult and costly. As a result, many of the beneficiaries had to abandon these projects soon after occupation and return to the cities after selling their rights to the plots to higher income groups. [20] Examples of rehousing and resettlement programs can be found throughout India, however, case studies have been primarily documented for the major urban centres of Delhi, Madras, Calcutta, and Bombay.

From 1975 to 1977 an "...emergency rule was imposed throughout India, civil liberties were curtailed and the police were given extraordinary powers." [21] During this period, local governments used the extraordinary powers granted to relocate a large number of slums. The largest mass relocations took place in New Delhi where "...16 new resettlement colonies were created to accommodate around 700.000 evicted squatters." [22] Bhatt indicates that after the emergency, the

implementation of new sites and services programs was temporarily slowed down. [23] However, the same author states that by 1986, the number of new site and services projects being built had risen significantly: in Delhi alone over 260,000 sites and services type plots had been developed under various schemes. [24]

3. SITES AND SERVICES PROGRAMMES: PRESENT TRENDS

There is no doubt that in India over the past thirty years a great deal of experience has been accumulated with regard to the implementation of sites and services projects. Yet, there is little change in planning practices in which economic considerations continue to be the primary design determinant. As examined in chapter one, the grid plan is the central characteristic of this approach. However, "as more and more sites and services projects are completed, it is becoming apparent that non-economic factors play an important role in their success." [25] Bhatt states that in India there is very little consideration given to the life style of the potential users of sites and services projects. [26] He cautions that "without adequate thought to the users needs and habits, money could be spent on wrong designs." [27] Bhatt illustrates this case with a sites and services project close to the city of Ahmedabad in which "...it was found that the typical service core, as designed and built for each plot, was changed by more than 90% of the occupants. [28]

The design of public open spaces in sites and services projects has been characterized by the use of conventional standards which do not reflect the traditional living patterns of the people living in low

income settlements. In this regard, Doshi writes that in India "...the usual norms and standards seem alien to the indigenous milieu and do not relate well with people's preferences and life styles." [29] In fact, current planning practices have frequently led to the design of streets and open spaces which are of very limited use and which usually represent nothing else but a waste of valuable land. For example, Bhatt writes that during a 1986 survey of the Jahangirpuri sites and services project in Delhi, he found that the design of large open spaces had been totally unsuccessful. He describes the situation as follows: open spaces in this project "...lie empty and are used either as refuse dumping grounds or defecation fields. Children prefer to use the edges of the large open spaces as regular defecation places instead of using the public toilets. The edges of wider roads along large open spaces are slowly being invaded by new migrants. It will not take very long before some of these open spaces are taken over completely by the new migrants." [30] This is just but one example of the limited level of understanding that exists regarding the nature of public open spaces in low-income settlements.

As indicated at the end of chapter I, the Centre for Minimum Cost Housing at McGill University in collaboration with the Vastu Shilpa Foundation in Ahmedabad, has been studying the activities that take place in streets and open spaces in informal settlements in India. The objective has been to identify the correlations which exist between different types of activities and the physical characteristics of the spaces in which these occur in order to produce a set of "...suitable guidelines and norms for architectural and settlement planning in the Indian contexts." [31]

Based on this research, the Minimum Cost Housing Centre has developed a new set of settlement standards or planning guidelines for the design of public open spaces in low-income housing projects. These guidelines "...introduce architects, planners and urban designers to new ideas for planning low-income housing that is more responsive to the demands of users, that is more effective at providing a good living environment, and that reflects a sensitivity to the lifestyle of the urban poor." [32] Organized under the following five headings, the planning guidelines examine different aspects of the use and design characteristics of public open spaces in low-income settlements:

Neighbourhood Streets: studies the different patterns of use of streets and open spaces in relation to their size, location, and configuration.[33]

Small Shops: describes the different ways in which small-scale shops are integrated into the housing environment. [34]

Work Places: examines the wide range of income-generation activities that take place in and around the house, as well as "...the variety of spatial requirements that the different work activities..." demand. [35]

Trees and Public Spaces: examines how the use of trees can greatly influence over the use of public spaces and at the same time improve the environmental quality of the public realm. [36]

House Extensions: Studies the ways in which houses extend into the street, and how these spaces are used. [37]

A review of literature relevant to the principles articulated in the planning guidelines is presented in the following chapter.

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CHAPTER IV

THE PLANNING GUIDELINES

The principal characteristic of the sites and services approach is that it encourages a great deal of self-help on the part of the users, primarily through the design and construction of the houses. This characteristic has significantly changed the traditional role of architects and planners who no longer deal with the design of individual houses but with the lay out of plots, streets and public open spaces.

As it has been documented throughout this study, current planning methodologies do not deal effectively with the activities that take place in public areas. The 'planning guidelines' introduce an alternative planning method which incorporates new ideas for the design of streets and public open spaces in low-income areas. This planning methodology is based on a simple set of rules which are easy to use. Its goal is to generate housing environments that are more responsive to the needs and lifestyles of the urban poor at little or no extra cost.[1]

The guidelines cover the following five areas: (1) neighbourhood streets; (2) work places; (3) small shops; (4) trees and public spaces; (5) house extensions. From these five areas, the most important group of guidelines is the one relative to the design of neighbourhood streets, given that it contains the planning principles which determine a project layout, the land-use patterns and, consequently, overall development costs. The neighbourhood street planning guidelines are classified according to scale of the streets, their use patterns, and the nature of traffic, into four categories: 1. lanes, 2. small

streets, 3. access roads, and 4, street widenings. A literature review of the principles present in the guidelines is introduced in the material which follows. This review has been structured along each of the above groups. Each section concludes with the introduction of the suggested planning guidelines.

1. NEIGHBOURHOOD STREETS

In addition to accommodating movement, streets in unplanned settlements are important spaces for social and cultural interaction. Streets are also places where work, shopping and commercial activities are performed. [2] However, streets in most modern low-income housing projects are essentially planned as circulation channels. Their design and construction is commonly based on imported, and often excessive norms and standards which evidence the limited understanding of the land use patterns, and the type and frequency of traffic which take place in informal settlements.

The neighbourhood street planning guidelines propose a methodology for the design of streets and public open spaces which is based on a new set of norms and standards that are not only affordable but which recognize the social needs and the traditional living patterns of the urban poor. Given that this planning approach has been focused at the scale of the neighbourhood, the first step in this study has been to examine various concepts which attempt to define with the size of residential areas.

1.1 The Scale of Residential Areas

As stated earlier, one of the most common characteristics in the design of modern low-income housing projects has been the use of the grid plan. This planning strategy has been widely implemented all over the world in the design and construction of extremely large projects which are in sharp contrast with the relatively small size of residential areas found in informal settlements. The design of large scale, grid planned, housing projects with no clear hierarchy of residential areas has seriously affected, if not completely destroyed, the notion of community and neighbourhood.

New planning theories, such as the one developed by Christopher Alexander, have recognized the need to limit the scale of residential areas to ensure the success of any housing project. In Alexander's approach, residential areas are classified at three levels: 1. community; 2. neighbourhood; and 3. house cluster.

1.1.1 Community level

Alexander writes that "individuals have no effective voice in any community of more than 5,000-10,000 persons." [3] He claims that this figure needs to be observed if people are to effectively participate in a residential community operating as a viable political unit. He advocates that people in communities this size have "...the power to initiate, decide, and execute the affairs that concern it closely: land use, housing, maintenance, streets, ... neighbourhood services." [4]

1.1.2 Neighbourhood level

The basic precept at this level is that people "...want to be able to identify the part of the city where they live as distinct from all others." [5] Alexander indicates that "available evidence suggests, first, that the neighbourhoods which people identify with have extremely low populations; second, that they are small in area; and third, that a major road through a neighbourhood destroys it." [6] He states that the ideal size of neighbourhood should not be more than 300 yards across and should not have more than 400 or 500 inhabitants. [7] Alexander also underlines the importance of clearly defining neighbourhood boundaries. He writes that "the strength of the boundary is essential to a neighbourhood. If the boundary is too weak the neighbourhood will not be able to maintain its own identifiable character." [8] He further indicates the need to "encourage the formation of a boundary around each neighbourhood to separate it from the next door neighbourhoods ...by closing down streets and limiting access to the neighbourhood ...and by making the boundary zone wide enough to contain meeting places for the common functions shared by several neighbourhoods." [9]

1.1.3 House cluster

Alexander writes that "this pattern is based on the idea that the cluster of land and homes is ...the source for gradual differentiation of neighbourhood land use, and is the natural focus of neighbourly interaction." [10] He indicates that the maximum size for a cluster should be of 8 to 12 households. However, he observes that the average number of houses in a cluster should be between 6 and 8. [11]

Rybczynski emphasizes the fact that the above patterns should not be taken literally given that these vary from culture to culture. In fact, most of the patterns so far developed by Alexander are explicitly for the North American or European contexts. [12]

Quoting Hall, Mellin writes that defining the concept of neighbourhood in India is very difficult because such definitions seem to be dependent upon the contextual circumstances and the extent of the resident's social contacts. [13] Nevertheless, the researchers at Vastu Shilpa Foundation write that in the older parts of some Indian cities, the presence of neighbourhoods, better known as mohallas or poles, is clearly evident. The foundation indicates that in such cases the size of these neighbourhoods "...vary substantially so that some are merely a few clusters strung together, whereas others are larger entities with around 500 households." [14]

In an effort to draw guidelines to establish the size of residential areas for its 'Perspective Plan 1974-84', the government of the state of Gujarat conducted a study which concluded that the average size of a neighbourhood should be of about 500 people. The plan, however, did not provide any indication as to the optimum area of the neighbourhood. [15]

On the other hand, sociological studies, such as the one conducted by Anthony Wallance in Housing and Social Structure, claim that regardless of the socio cultural context " anthropological evidence suggests that a human group cannot coordinate itself to reach agreement on basic decisions affecting the group if its population is above 1,500." [16]

From the existing literature it appears that, in the Indian context, the answer to the question 'what is the right population for a neighbourhood ?' is far from being settled and that further research is required to determine realistic parameters with regard to the optimum sizes of residential neighbourhoods.

1.2 The Scale and Land Use Patterns of Streets and Open Spaces in Informal Settlements

The circulation networks of slums and unplanned settlements in India are characterized by a clearly defined hierarchy of lanes and small streets of varying widths, which are organized in an informal way. Payne indicates that this hierarchy of circulation spaces usually reflects the patterns of development of the settlement. [17]

In the early 1970s, Payne, in his study about the nature of space utilization in the Rouse Avenue settlement in New Delhi, observed that the circulation network of that settlement was basically defined by five types of spaces. He described each of these spaces as follows:

> " 1. the main service road, which also serves as the central social, commercial and industrial area; 2. the secondary spine paths, which provide access from this road to the various hutment groups; 3. the narrow lanes which connect the one housing group with another; 4. small chouks or open spaces which occur at the intersection of various paths and often exploit the existence of a small shading tree and 5. small cul-de-sacs which provide access to self-contained groups of huts." [18]

The neighbourhood street planning guidelines propose a method of classification of circulatory spaces which is based on the physical character, the nature of traffic, and the patterns of space utilization, that take place in streets in informal settlements. Similar to Payne's

findings, the planning guidelines classify streets in four categories: 1. lanes; 2. small streets; 3. access roads; and 4. street widenings. [19] The physical characteristics and the use patterns for each of these four categories are as follows:

1.2.1 Lanes

"Lanes are the narrowest circulation links, connecting small streets. They are usually 1.5 to 3 meters wide." [20] It is important to bear in mind that the length of the lane is a factor that requires special consideration, given that long narrow lanes do not function successfully, and usually end up as dumps for refuse and garbage. [21] Lanes and dead-end lanes represent approximately 10% of the circulation.

Traffic on narrow lanes is limited to pedestrians and occasional bicycles. Additionally, lanes provide access to only a small number of houses and are consequently less exposed to passersby. As a result, lanes and dead-end lanes tend to acquire a private character which facilitates their use for relatively private domestic activities such as cooking and washing. Payne observes that in low-income neighbourhoods, dead-end lanes "...are regarded and used as extensions of the private open space. Such areas are commonly used for open air sleeping in the summer and for cooking throughout the year." [22] Lanes are also used on special occasions to hold festivities and ceremonies. Given their private character, lanes are better maintained than larger streets, as the families sharing them feel responsible for their upkeep. [23] Generally, it is preferable "...to avoid lanes on which houses do not front since they loose their domestic character and end up being used as

storage or parking spaces." [24]

Based on the above considerations the following planning guidelines were drawn:

Planning Guidelines:

A. lanes should be wider than 1.5 meters;

B. lanes should have house entrances;

C. lanes should be shorter than 15 meters;

D. dead-end lanes are the most desirable. [25]

1.2.2 Small Streets

"Small streets are defined as being 3-5 meters wide, and giving access to individual houses." [26] In low-income neighbourhoods this type of streets constitute the larger percentage of the circulation network. The traffic on small streets mostly consists of pedestrians and slow-moving vehicles such as bicycles and pushcarts which are commonly used for transporting and selling goods. Given that pushcarts have a maximum width of 1 meter they do not require wide streets. "Other vehicles that circulate on small streets include auto-rickshaws and pedal-rickshaws which are 1 to 2 meters wide." [27] Small streets can also accommodate the circulation of occasional cars if required.

Besides circulation and access, "...small streets in low-income neighbourhoods accommodate a variety of household, economic, and social activities." [28] These streets are characterized by the presence of house extensions which provide spatial variety and setting for different activities. Additionally, the special character of neighbourhood streets "...is further enhanced by the presence of special features such

as gates and small religious shrines." [29]

The Centre for Minimum Cost Housing reports suggest that the physical configuration of small streets can exert a significant level of influence over the types of activities that take place in the street. For example, the Centre staff found that in low-income settlements in India, streets of varying widths encourage the multiple use of the public space. A similar finding is presented by Alexander who indicates that in order to encourage people to stay in the streets and not to pass through, streets should bulge at some intervals, making the ends narrower to form an enclosure which becomes a place to stay and not to pass through. [30] The Vastu Shilpa Foundation staff supports this view and affirms that "...the shape may critically determine the symbiotic use of the street." [31] The Foundation report indicates that small streets in unplanned settlements are characterized by the use of twists and staggers in the street pattern and by widening and narrowing the street's width.

Planning Guidelines:

A. small streets should be between 4 and 5 meters wide, and should have a clear vehicular access of 2.5 meters.

B. small streets of varying widths, connected by lanes, should be substituted for rigid gridiron layouts. [32]

1.2.3 Access Roads

Access roads are major thoroughfares, 5-9 meters wide, connecting residential neighbourhoods to the city's circulation network. Access roads are characterized by their "...continuous flow of pedestrian and

vehicular traffic; they are the main activity spines of the community."[33] Traffic in main access roads includes bicycles, auto-rickshaws and pushcarts, as well as larger vehicles such as bullock carts, tempos, cars and taxis. They are also occasionally used by slow-moving trucks and vans. "Despite their heavy vehicular traffic, access roads are not simply automobile carriers. Vehicles of all sorts have to co-exist with the pedestrian flow, as well as with the various activities that take place at the edges of such roads." [34]

Access roads in unplanned settlements do not follow a regular pattern of development. Instead, they are characterized by frequent changes in width and shape. These physical characteristics make through traffic not only slow but inconvenient. The limited speed of vehicular movement in combination with the shape of these roads are the main factors enabling pedestrians and cars to co-exist. This, in turn, facilitates the multiple use of the space.

In low-income neighbourhoods, access roads are ideal for commercial activities. They support relatively local non-residential activities ranging from commercial uses, like temporary and permanent shops and workshops, to local bazaars with hawkers. Additionally, public structures such as large temples are commonly situated along access roads. These places usually become important gathering spaces for the whole community. [35]

Planning Guidelines:

A. provide a clearly defined access road to each neighbourhood;

B. provide space for small kiosks and shops along the edges of access roads;

C. design access roads to discourage through traffic. [36]

1.2.4 Street Widenings

"Street widenings are small, open spaces that are an expansion of the street space. They include enlarged street intersections and small squares." [37] Small streets widenings, 2 to 3 meters wide, can be used for domestic activities. Larger street widenings are 3 to 5 meters wide. Besides domestic activities, they can accommodate community and commercial activities. Payne writes that these small open spaces "...are regarded as extensions of the private open space for certain functions such as working, sleeping, male meetings, children's play and domestic industry." [38] Vastu Shilpa researchers observes that these types of spaces tend to be less public and, therefore, have their territoriality more defined.

Widenings located at street intersections have a more commercial character because of the greater exposure to passers-by. It is not uncommon to find in these places small vegetable stands or tea shops. Streets widenings are also used to set up temporary work places.

Trees planted in small and large street widenings can increase the intensity of land use. For example, a small street widening with a shade tree is usually a perfect place for working. In large widenings, trees in combination with low platforms become ideal places for social gatherings and group activities. [39]

"A larger more defined street widening produces a small square. These public spaces can accommodate public gatherings, festivities, work activities and a number of other social and cultural functions related

to the lifestyle of the people living in low-income neighbourhoods." [40] The Centre for Minimum Cost Housing staff have observed that small squares in unplanned settlements have a high land use value. The high level of activity in these places seems to be mostly determined by the scale of the squares and their level of integration to the surrounding buildings and street life. The Minimum Cost Housing Centre staff have also observed that large squares in planned low-income housing projects tend to remain empty and evidence very limited use. [41]

Similarly, Alexander writes that in modern cities, architects and planners continue to build plazas that are too large. He states that although these spaces look good on drawings, in real life they end up isolated and dead. His observations have led him to "...suggest strongly that open spaces intended as public squares should be very small." [42] Alexander indicates that small squares should be about 14 meters to 18.5 meters across and should never exceed more than 21.5 meters across. [43] In low-income settlements, small squares are defined by the houses that border them, providing a sense of enclosure. In these cases, the households living around the square can use the perimeter for domestic activities, while leaving the central portion for public use. However, when these open spaces are divorced from the street life they remain unused and only represent a waste of valuable land. [44]

In the design of these public open spaces special consideration must also be given to the planting of trees. Observations conducted by the Minimum Cost Housing Centre staff show that small squares in informal settlements with centrally located trees and platforms are customarily used as neighbourhood community centres for larger gatherings. [45]

Planning Guidelines:

A. provide small street widenings, about 2-5 meters wide, to be used as public outdoor rooms for socializing at the cluster level;

B. enlarge street intersections so that they provide small spaces for hawkers, small shops and work places; [46]

C. it is more effective to provide several smaller squares, with no dimension larger than 15 meters, instead of one large, central green space. [47]

2. SMALL SHOPS

One of the central characteristics of commercial activities in unplanned settlements is that shops have traditionally been combined with housing. However, in most modern, planned housing projects large housing areas are left "...without any provision for small shops and commercial activities. As a result, it is not uncommon to see improvised, shopping areas springing up along major roads and on street corners. Because sufficient space has not been set aside, they frequently block the sidewalks and obstruct traffic." [48]

Commercial activities in planned low-income housing projects are usually organized around centralized markets and shopping centres. But centralized formal shopping centres are not a solution. When planned and constructed, these commercial areas remain empty and unused. The study of the physical and operational characteristics of small shops in informal settlements helps to explain why centralized markets fail and why "...the concept of centralized shopping is inappropriate to the living patterns found in the informal housing sector." [49]

2.1 Types of Shops and their Physical Characteristics

Small shops sell a variety of products which can be broadly classified into two categories: 1. shops that sell mainly commodities; and 2. shops that sell mainly services. [50]

2.1.1 Small shops selling commodities

These types of shops fulfill an important function in low-income neighbourhoods given that residents need to buy small quantities of food on a daily basis. Commodities used daily, like vegetables and fruit, are primarily sold from pushcarts. Other products such as matches, beedies, soap, packets of tea and so on are usually sold from more permanent structures such as kiosks. [51]

2.1.2 Small shops providing services

"In addition to food and daily items, small shops also provide services directly to the community, like ironing and laundry shops...", barbershops, and roadside metalwork shops which repair tools and kitchen implements. [52]

Small shops can also be classified in terms of their physical character into three groups: shops that are detached from the house; shops that are a part of a home; and mobile shops.[53]

2.1.3 detached shops

These are shops with no physical structure, such as the street hawkers. They represent the simplest form of a detached shop. Shoe repair stands, locksmiths, vegetable stands are examples of this type of

shop. A more permanent detached shop is the kiosk which can be as small as 2m x 1m. Bicycle repair and paan shops usually operate in this kind of structure. [54]

2.1.4 Part of the home

Small shops are often incorporated into the home. While they are usually set up in a front room or a house extension, sometimes this type of shop can occupy the entire ground floor of the house. Corner tea shops, grocery shops, and shops that sell seasonal items like kites or bracelets (rakhis) are examples of this kind of commercial structures.[55]

2.1.5 Mobile Shops

The principal characteristic of these types of shops is that they can move around the neighbourhood, bringing its products directly to the customers. The most typical mobile shop is the four-wheel push-cart, which is mainly used for selling fruits and vegetables. Bicycles, however, are also widely used, as well as small refrigerated cars.

Based on the above considerations it is possible to observe that "...small shops are characterized by: a. their small size; b. their proximity to homes; and c. their ability to cater to local needs." [56]

2.2 Location

Location is perhaps the single most important factor for any shop to succeed and small shops in low-income neighbourhoods clearly follow this commercial principle. They are usually located where there is the greatest exposure to passers-by. Following the hierarchy of the

neighbourhood streets they are primarily located along the main access road, around squares and public open spaces, at street intersections, and sometimes along smaller streets. [57]

2.3 Economic Advantages

Small shops have various economic advantages over commercial centres and planned markets. "When shopping and living activities are combined, one gives way to the other as the need arises, making use of all available space." [58] Additionally, small shops are an important way to increase the family income. Their small scale allows people to undertake commercial activities with very small resources, and allows different family members to run it at "...different times, when they are free, hence providing many economic and social benefits." [59]

Summing up, "...the main advantages of small shops in low-income urban neighbourhoods are: (a) they can be started and operated with a minimum investment; (b) they do not require much space; (c) they encourage family enterprise; and (d) they can be suitably located to reflect user demand." [60]

Planning Guidelines:

A. avoid planned, formal markets which are inappropriate places for small commercial activities in low-income areas;

B. provide spaces for hawkers and temporary stalls in small squares and in specified areas along major streets.

C. modify zoning regulations to allow house-owners along major streets and at road junctions to convert a part of their home to commercial use. [61]

3. WORK PLACES

One of the key organizational principles adopted in the planning of most modern cities is to establish separate zones for 'work' and for 'living', a separation which in most cases is enforced by law. [62] According to Alexander, there are two arguments which are given to justify this separation: first, that "...work places need to be near each other, for commercial reasons. Second, that work places destroy the quiet and safety of residential neighbourhoods." [63] Alexander claims that this separation of houses and work is an artificial measure which only accomplishes "...intolerable rifts in people's inner lives." [64] In order to overcome this effect, he advocates the use of a highly decentralized pattern of work.

> "Use zoning laws, neighbourhood planning, tax incentives, and any other means available to scatter work throughout the city. Prohibit large concentrations of work, without family life around them. Prohibit large concentrations of family life, without work places around them." [65]

In contrast with the planned segregation of 'work' and 'living' that takes place in most modern cities, unplanned settlements are characterized by a combination of family, social, and work activities. This integration of "...work and living areas provides the economic and social benefits of increased family income using modest, existing resources. Unfortunately, most modern housing usually ignores the importance of providing small work areas and misses an important opportunity to encourage people to help themselves." [66]

Work activities in low-income neighbourhoods tend to be small scale commercial activities which require little or no investments from

outside the community. They are characterized by their ability to take advantage of existing entrepreneurship and commercial know-how within the neighbourhood. [67] These work activities take many forms. In the first category are service industries serving the immediate neighbourhood. Bricklayers, small carpenter workshops set up in the street, craftsmen providing furniture repair service from house to house and tailors are examples of the types of work in this first group. The second category involves producing articles for the larger urban market. At this level, raw materials purchased in the city are reprocessed into sellable items, such as brooms made from dried palm leaves, animal harnesses made from waste materials such as cloth or wool, and sandals made from old automobile tires. [68]

The great variety and complexity of work activities found in informal settlements also revealed the need for a wide range of work spaces in terms of sizes, shapes of space and location. The spatial requirements "...varied from as small as 2 square meters, in the case of paper bracelets, to as much as 36 square meters for the repair and refurbishment of wooden crates." [69] In terms of location, most work activities take place either directly on the street or in the house extensions.

Planning Guidelines:

A. modify zoning bylaws to encourage the integration of workplaces in the home;

B. plan public spaces such as small squares, road widenings and dead-end streets, so as to accommodate a wide range of small-scale work activities;

C. make marginal land, in close proximity to housing, available to small entrepreneurs. Do not provide buildings. [70]

4. TREES AND PUBLIC SPACES

Traditionally, trees have had "...a very deep and crucial meaning to human beings." [71] In India, for example, the significance of trees is oftenly expressed through the social and religious activities that are centered around them. Alexander indicates that trees play a vital role in the public environment, and considers "...that trees along with houses and other people, constitute one of the three most basic parts of the human environment." [72] He observes that "trees have the potential to create various kinds of social places: an *umbrella* where a single, low-sprawling tree like an oak defines an outdoor room; a *pair* - where two trees form a gateway; a *grove* - where several trees clustered together; a *square* - where they enclose an open space; and an *avenue* - where a double row of trees, their crowns touching, line a path or street." [73]

Low income neighbourhoods in India are often characterized by the large numbers of trees that are planted, maintained and protected by the residents. Families living in poor areas maintain and protect trees because these serve diverse functions and support many domestic activities. For example, during the summer months, trees provide shaded areas that are used for community gatherings, sitting, and sleeping, as well as for household activities such as washing clothes and cleaning kitchen utensils. When trees are planted at street intersections and along main roads, they create shaded areas that are ideal places for hawkers and small shops and stalls. Trees are also used "...as

structural supports for drying clothes, and for building small leantos or house extensions." [74] Additionally, during the winter time, pruned branches are used as fuel for cooking.

For the individual family, fruit bearing trees such as coconut, banana, and papaya, have a significant commercial value because they usually become an additional source of income. Other trees such as banyan and pipal have religious significance and are commonly associated with shrines and temples. [75]

The above examples demonstrate how trees can enrich the living environment. However, it is essential to underline "...that the mere provision of trees is not enough; they must be well located. There are four locations where trees seem to perform a useful role in housing areas:" [76]

(a) private yards and courts: people often plant shade trees in front of their homes and fruit trees in small adjacent gardens. Trees in front of the house usually become a support for a house extensions or for fastening rope in order to dry laundry. Fruit trees planted in small private yards are exclusively used by individual families given that they maintain the tree and harvest the produce. [77]

(b) street curbs: shade trees such as asoka, mulberry, and drumstick seem to be the most appropriate species for street curbs. Double rows of shade trees are usually planted in streets wider than five meters. Single rows of trees can be used in small narrow streets. [78]

(c) street widenings: these places are commonly used for working and resting. The use of platforms shaded by trees at these locations can significantly encourage the more efficient use of the space. [79]

(d) small squares: these open spaces require larger shade trees such as banyan, karanj, neem, palmira, and coral. [80] "Such large trees usually become landmarks, and the space around them is used by the whole community." [81]

The guidelines developed by the Centre for Minimum Cost Housing advocates the need to consider trees as an integral "...part of the basic infrastructure that is supplied by the housing authority in sites and services projects." [82] The Centre also highlights the need to plant the trees during the early stages of the construction process, "...so by the time the project is ready for occupation, the trees are large enough to serve a useful purpose." [83]

Planning Guidelines:

(A) plant trees along both sides of main access roads to provide shade for commercial activities.

(B) provide trees with low plinths at major street widenings and in small squares to serve social and commercial activities;

(C) plant trees at minor street widenings to provide shade for social and work activities. [84]

5. HOUSE EXTENSIONS

House extensions are the "...spaces in front of the home that are nominally a part of the public realm, but that have acquired a private character through use and physical modifications." [85] These spaces represent an intermediate zone between the house and the street. Depending upon their size and physical characteristics, house extensions can be accommodate domestic activities as well as small shops,

workshops, and home industries.

House extensions have been classified into five categories:

(a) Stoops: these are the smallest and cheapest type of extension. Stoops are enlarged steps constructed with beaten earth, stone or concrete. They are usually less than 1 metre wide. However, their sizes are mostly limited by the width of the streets and the type of traffic. Stoops are generally used as seats or as workbenches.

(b) Platforms: these are the most common type of house extension. Although similar in character to the stoop, the platform is a larger type of extension, up to two meters deep. Unlike stoops, platforms present a larger change in level which clearly marks the private area and controls the traffic. Platforms commonly accommodate a wide range of household activities such as food preparation and cooking and grain drying. During the summer months, these areas are frequently used for family gatherings as well as for sitting and sleeping during the day, and at night. Platforms are found in wider streets or streets with very little traffic. [86]

(c) Porches: these are platforms or stoops which have been covered with a roof. The porch is a classic Indian architectural device present in almost all hot climates. The porch provides a shaded space which functions as an outdoor room. Porches serve the same purposes as platforms. They are also used as storage spaces for household goods, and small vehicles such as pushcarts, mopeds and bicycles. [87]

(d) Outdoor Rooms: when a porch achieves a greater privacy through the use of walls on one or two sides it is considered an outdoor room. These spaces are normally very wide and vary in depth from 1 1/2 m to 2 1/2 m.

Besides storage, outdoor rooms are commonly used as bathing areas. [88]

(e) Yards: they are the largest form of house extension. Given their size yards are less common in dense poor areas. Yards are usually fenced and are mostly used for gardening, parking small vehicles and keeping animals. [89]

Besides enriching the built environment and promoting the multiple use of the space, house extensions provide several important benefits to the individual: "they are ideal places for many outdoor domestic activities; they encourage social interaction between the family and the street; and they provide an inexpensive addition to the house area." [90]

Planning Guidelines:

(A) provide space for house extensions, varying from less than one meter to a maximum of two meters, depending on the street width, housing density and space available;

(B) for large plots, require a setback to encourage house extensions;

(C) for small plots, permit a restricted use of the public space for stoops, platforms, and porches. [91]

From the five groups of guidelines studied, the neighbourhood streets planning guidelines present the most crucial design considerations of all given that they contain the design principles which determine a project layout. These set of guidelines not only exert direct influence over the spatial characteristics of a project, but they certainly have direct implications over the quantities of infrastructure, thus influencing total project costs.

On the other hand, all the other groups of guidelines contain

principles that are either essential to improve the environmental quality of a project, such as the planting of trees, or to facilitate the more effective use of the public land for income generating activities such as the setting up of small shops and work places.

Given that the neighbourhood street planning guidelines determine a project layout and its cost, they are the main focus of this study. The main objective in this case is to test their effectiveness and economic implications. However, given that house extensions play a fundamental role in determining the overall land-use areas, the study of this other group of guidelines is also included. The methodology used for testing these sets of guidelines is explained in the following chapter.

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CHAPTER V

METHODOLOGY

This chapter describes the methodology used to evaluate the efficiency of the neighbourhood streets planning guidelines in the design of sites and services projects. For the purposes of this thesis, infrastructure efficiency was used as a means to test a series of neighbourhood plans generated by the guidelines. In each case, linear measurements of the service networks were taken for determining the quantities of infrastructure.

1.1 The Control Plan

The first step was to define a set of design parameters common to the design of all neighbourhood plans. The objective was to determine a common framework which would allow the comparison and analysis of different design alternatives on an equal basis. This set of design parameters was extracted from a typical neighbourhood plan of an existing sites and services project. This plan, which was designated as the **control plan**, was selected because it reflects the traditional approach to the design of sites and services projects. It is characterized, as shown in figure No.1, by a grid iron layout, streets of constant widths, and a large, centrally-located open space.

Five design parameters were identified and used as **constants** from the control plan:

1. same site area and shape (174 m x 109 m);
2. same width for site peripheral streets (7 m, 9 m, 13 m);
3. a standard family plot size (3 m x 7 m);

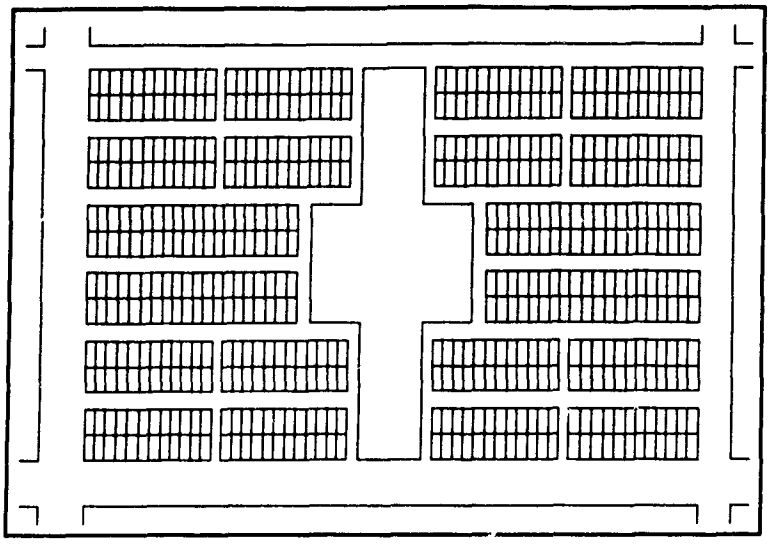

FIGURE NO.3 CONTROL PLAN

4. same number of plots (544 units). The percentage of private land remained constant in all options;
5. maintain back to back grouping of plots as much as possible.

The first two constants are illustrated in figure No.2.

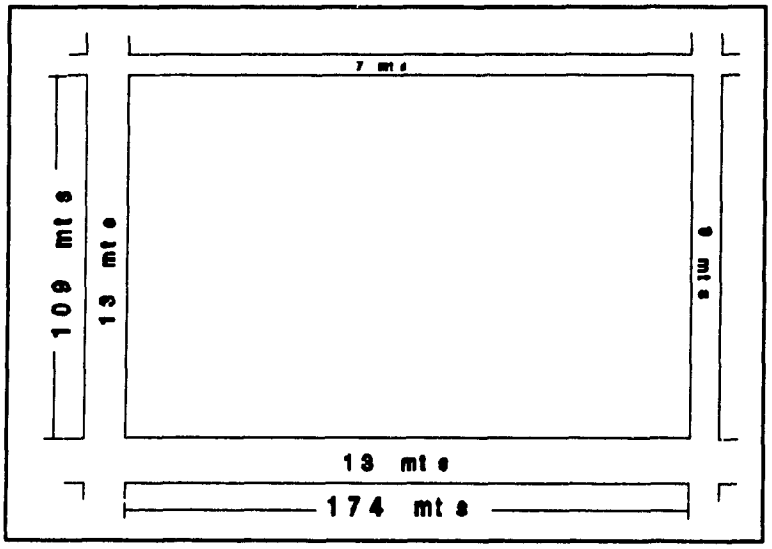

FIGURE NO.4 DESIGN PARAMETERS

The second step, after having defined the above constants, was to determine a set of rules to: (a) quantify land-use and (b) lay out and

measure the various infrastructure services under consideration. These new parameters, explained in sections 1.2 and 1.3, were identified as **control measures.**

1.2 Land-Use

Three **variables** were studied with regard to land-use:

1. Public Open Spaces: defined as physically controlled areas to be used by a limited number of people, where occasional household, religious, commercial, recreational and work activities are performed.
2. House Extensions: defined as "the space in front of the dwelling that is normally a part of the public realm, but which has acquired a private character through its use and physical modifications. Thus, it represents an intermediate zone between the home and the street."[1]
3. Areas for Circulation: defined as the portions of the street reserved for access and movement which are accessible to all members of a community.

In the control plan , as well as in the other plans studied, these variables were quantified in square metres and later translated into percentages of total land use for comparison and analysis.

1.3 Infrastructure Efficiency

In all the neighbourhood plans, linear measurements of the service networks were taken to determine the quantity of infrastructure, with the exception of street pavement. In this last case, the quantity was

expressed in square meters. The four infrastructure services studied were:

- Water supply (length of network in linear metres).
- Sewage disposal (length of network and number of manholes).
- Electricity and street lighting (length of network in linear metres and number of poles).
- Street paving (square metre area).

A set of technical parameters was developed to establish a common framework for the design and assessment of the infrastructure under consideration. The technical parameters determined for each case were:

1.3.1 Water supply

1. In laying out the main water supply lines, individual water connections had to be considered for all plots.
2. Only 50% of the total length of water supply lines running along the periphery of each neighbourhood was counted, while the remaining 50% was counted toward the adjacent neighbourhood.
3. All water supply lines were laid out on public land, preferably along the streets.
4. For individual connections, the maximum distance from the supply line to the plot was 10 metres.
5. Dead-end lines exceeding 15 metres were avoided in order to reduce problems related to stagnant water.
6. Limit the number of joints to the extent possible.

1.3.2 Sewage disposal

1. In laying out the main sewage lines individual sewage connections had to be considered for all plots.
2. Only 50% of the total length of sewage lines, running along the periphery of each neighbourhood was counted, while the remaining 50% was counted toward adjacent neighbourhood.
3. Only 50% of the total number of manholes located along the periphery of each neighbourhood was counted, while the remaining 50% was counted toward the adjacent neighbourhood.
4. All sewage lines were laid out on public land, preferably along the streets.
5. For individual connections, the maximum distance from the manhole to the plot was 10 meters.
6. Manholes were located at every turn and end of a line.
7. The maximum distance between manholes was 40 meters.

1.3.3 Electricity

1. In laying out electrical lines, individual drops had to be considered for all plots.
2. High tension lines and transformers were located in the periphery of each neighbourhood.
3. The neighbourhood was subdivided into four circuits, each serving approximately 25% of the plots. Given that the average consumption per plot was estimated at 1 KVA, each circuit was equipped with a 150 KVA transformer.
4. Poles were placed at every change of direction of the electrical line.

5. The maximum distance between poles was not to exceed 40 meters.
6. Individual drops should not be longer than 30 meters.
7. Street intersections were considered to be the most desirable location for street lights.

1.3.4 Street Pavement:

1. The sections of the street to be paved were those intended for vehicular traffic only. Setbacks intended for house extensions and street widenings, where different public activities occur, were left unpaved.
2. The following streets were to be paved:
   - the main access road to the neighbourhood;
   - secondary streets intersecting the main access road and ending in a small square;
   - secondary streets connecting the neighbourhood to main access peripheral roads.
3. The following streets were not to be paved:
   - lanes and dead-end lanes;
   - secondary streets linking lanes.

After defining the above principles, land-use and infrastructure quantities of the control plan were measured. The results were used as a bench mark to compare and assess the efficiency of the different neighbourhood plans.

1.4 Development of Design Alternatives

The operating rules used to develop each design alternative were

based on a three-step design process:

1. The first step, after completing each neighbourhood design, was to determine the land-use percentages. These results were assessed against the percentages achieved in the control plan.

2. The second step was to lay out the service networks according to the design parameters. The results obtained were evaluated against those achieved in the control plan.

3. The third step was to identify which guidelines helped or affected negatively the performance of the design alternative in order to encourage or modify their use. In every case, these evaluations led to the design of a new plan which attempted to match the infrastructure efficiency of the control plan, while incorporating most of the guidelines.

This cyclical process was followed in four design alternatives which are introduced below. The detailed results obtained in each case are presented and analyzed in chapter VI.

1.4.1 Design alternative # 1

The main concern in the development of this design alternative was to improve the environmental quality of the neighbourhood. In this case, it was assumed that the use of the planning guidelines would substantially improve its environmental quality. Thus, all seven neighbourhood street planning guidelines were incorporated into this first neighbourhood design, illustrated in figure No.5. In this case, no consideration was given to infrastructure efficiency.

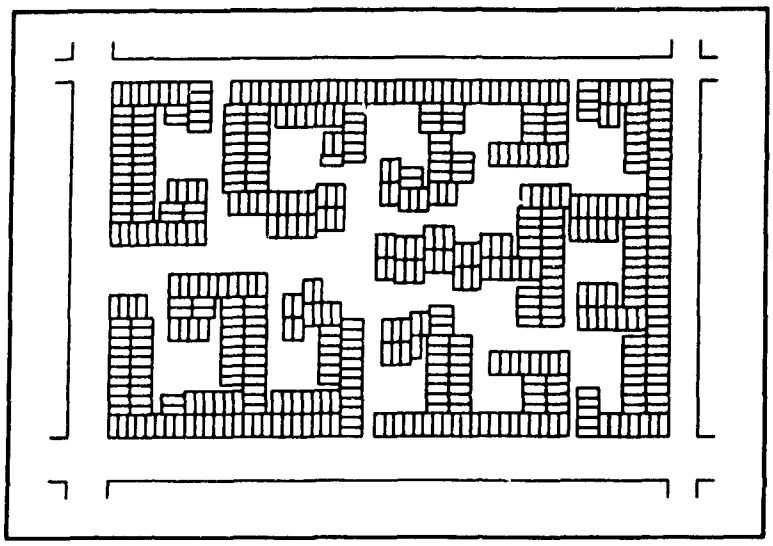

FIGURE NO.5 DESIGN ALTERNATIVE # 1

The results obtained showed a substantial increase in quantities of infrastructure compared to those in the control plan. To identify and isolate the possible causes for this increase, the physical characteristics of this design alternative were analyzed. This assessment showed that the main cause for the infrastructure increase came from the use of self-contained clusters. Thus, a second neighbourhood design was produced.

1.4.2 Design alternative # 2

The main objective in this new alternative was to achieve a layout that, while incorporating all of the guidelines, could produce an infrastructure network as efficient as the one achieved in the control plan. This new plan, illustrated in figure No.6, was based on the use of inter-connected clusters. After completing the second alternative, the infrastructure networks were measured. Although the results for

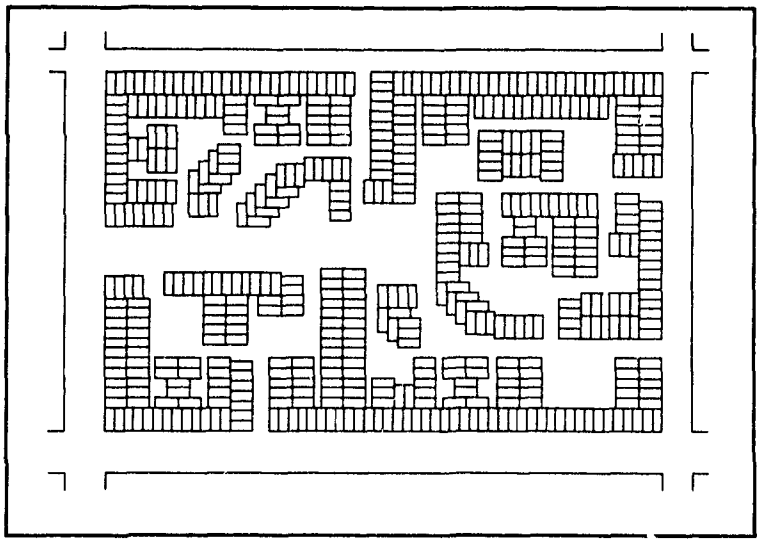

FIGURE NO.6 DESIGN ALTERNATIVE # 2

sewage and electricity were slightly better than those achieved in design alternative # 1, they were not as efficient as those of the control plan. Thus, a third neighbourhood design was developed.

1.4.3 Design alternative # 3

For this design, an attempt was made to identify the guidelines that were increasing infrastructure quantities in order to restrict their use. It was found that by avoiding the use of lanes and dead-end lanes, and by inter-connecting the clusters, a more efficient plan was possible. Despite avoiding the use of these guidelines, the results did not show a significant improvement over the figures achieved in design alternative # 2, and were not as efficient as the ones obtained in the control plan. Thus, a new alternative was developed.

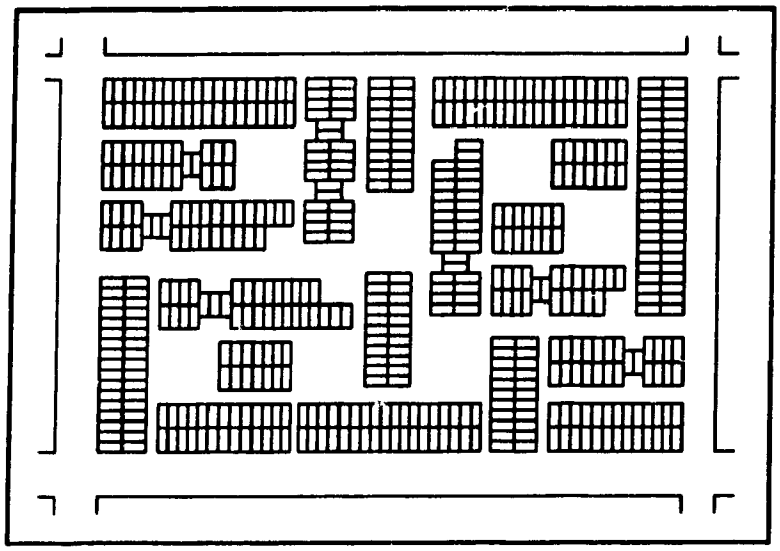

FIGURE No.7 DESIGN ALTERNATIVE # 3

1.4.4 Design alternative # 4

The main objective in this case was to improve the level of infrastructure efficiency while continuing the use of lanes and dead-end lanes as in the previous design alternative. This design alternative incorporated all of the other neighbourhood street planning guidelines. This new option, illustrated in figure No.8, was based on an existing neighbourhood plan prepared by the Vastu Shilpa Foundation for the Aranya sites and services project in Indore, India. The new design alternative proved much more efficient than the control plan.

A detailed description and evaluation of each plan are presented in the following chapter.

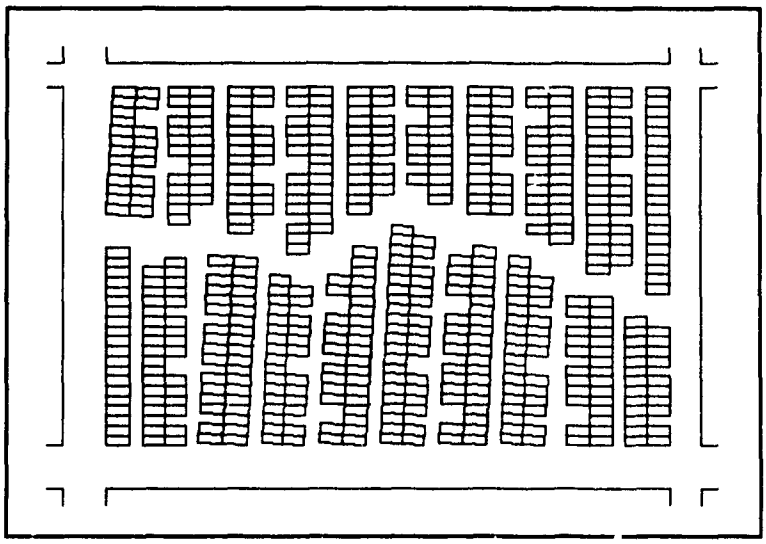

FIGURE NO.8 DESIGN ALTERNATIVE # 4

CHAPTER VI

DESIGN PROPOSALS

This chapter presents the data with regard to land-use and infrastructure efficiency for each of the five neighbourhood designs under consideration. The performance of each plan is evaluated by comparing the results attained in each case with those achieved in the control plan. All neighbourhood plans are also assessed by comparing the data of each individual case against the results of the other design alternatives.

1. CONTROL PLAN

This grid plan was selected because it represents the conventional approach toward the design of sites and services. In this case the plot layout, shown in figure No.9, is characterized by the use of back to back plots organized in rectangular blocks.

1.1 Land Use

The land-use analysis was based on the calculation of areas for circulation space, public open spaces and house extensions. The following were the results for each of the above aspects:

a. The total circulation area was 4,656 M2. These areas, shown in hatched in figure No.10, accounted for 24.54% of the total site area.

b. Public open spaces, illustrated in figure No.11, were restricted in this case to one large centrally located open space. The total area of this space was 2,886 M2 which accounts for 15.22% of the

total site area.

c. This plan does not include areas for house extensions.

d. The total private area of the control plan, shown in figure No.12, was kept constant (k) for all subsequent design options.

Summary

	M2	% of total site area
Circulation area	4,656	24.54%
Public open space	2,886	15.22%
Area of house extensions	0	0
Private area (k)	11,424	60.24%
Total	18,966	100.00%

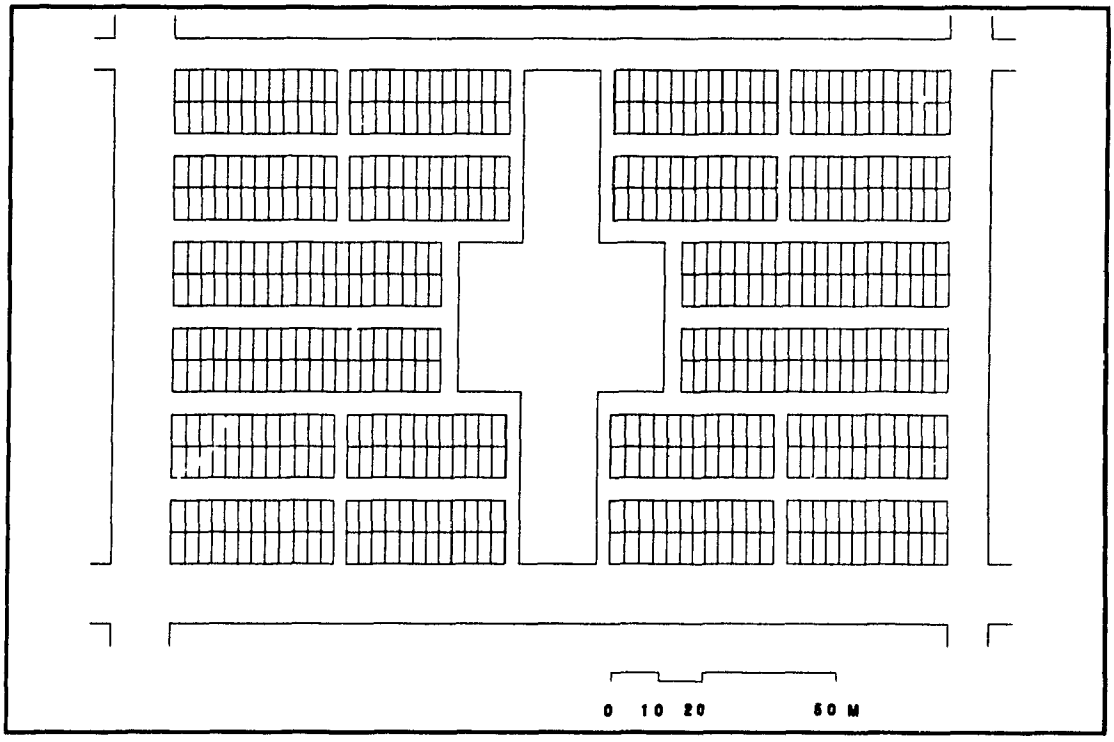

FIGURE NO.9 - PLOT LAYOUT - CONTROL PLAN

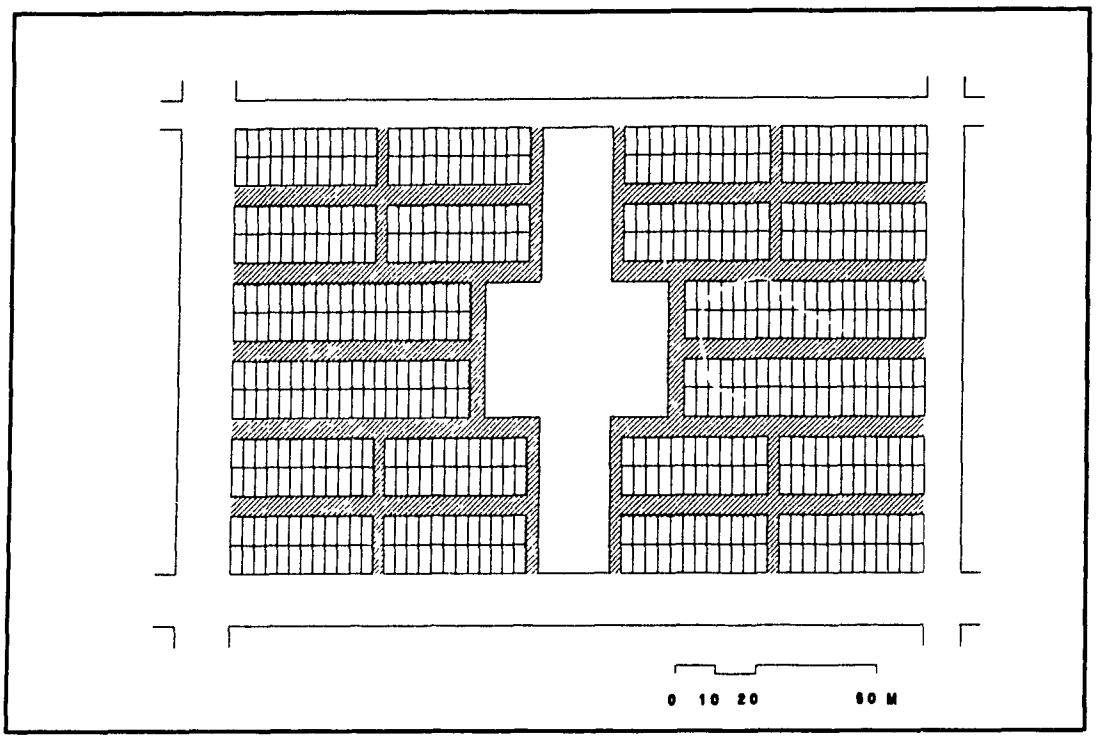

FIGURE NO.10 - CIRCULATION - CONTROL PLAN

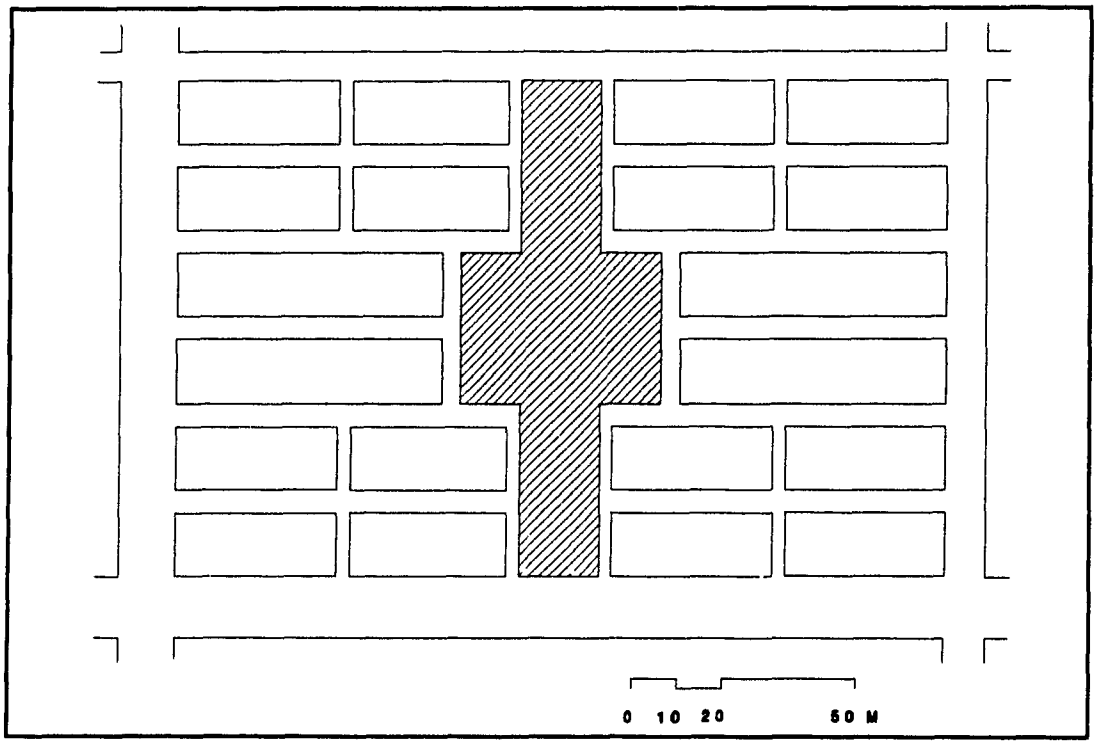

FIGURE NO.11 - PUBLIC OPEN SPACES - CONTROL PLAN

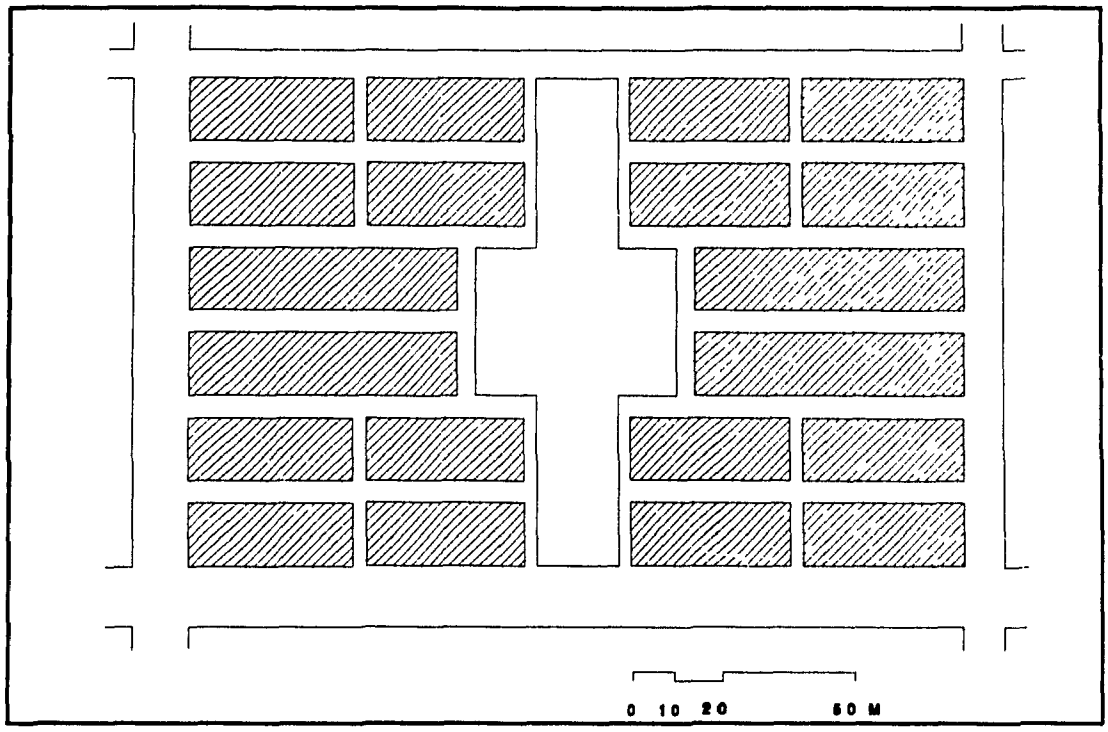

FIGURE No.12 - PRIVATE AREAS - CONTROL PLAN

1.2 Infrastructure

The infrastructure services studied were water supply, sewage disposal, electricity, street lighting and paving. The following section presents the design considerations observed in laying out each of the above services as well as the results obtained.

1.2.1 Water Supply

a. Connections to the main water supply lines, located along the neighbourhood's periphery, were provided at each intersection between a neighbourhood street and a peripheral street.

b. The main water supply lines, illustrated in figure No.13, were laid out along the streets to facilitate their installation and upkeep.

c. All supply lines were located at a maximum distance of 10 mts from individual plots.

The total length of the water supply lines were of 1,333 mts.

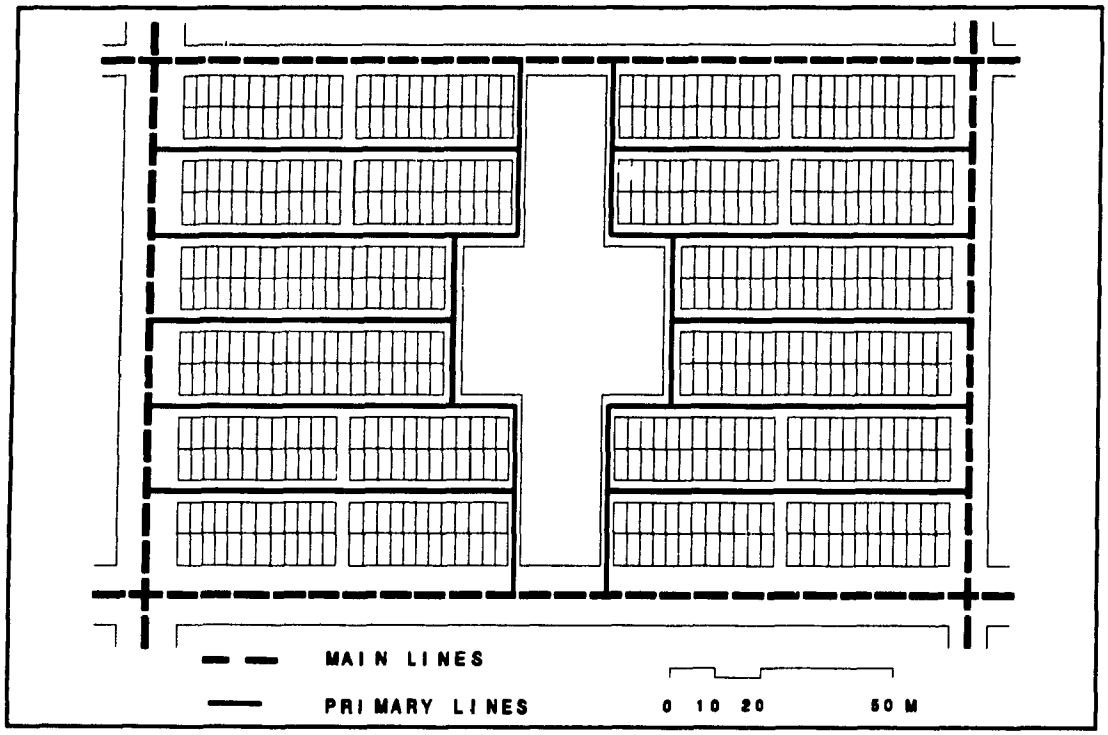

FIGURE No.13 - WATER SUPPLY - CONTROL PLAN

1.2.2 Sewage Disposal

a. The main collection lines, which were assumed to be part of the urban network, were located along the periphery of the neighbourhood.

b. At the neighbourhood level, primary collection lines, shown in figure No.14, were laid out along the streets to ease their installation and maintenance.

c. Spacing between manholes was set at a maximum distance of 18 mts,

so that an average of 6 plots on either side of the street were connected to each manhole.

d. Manholes were located as every intersection between the main lines and the primary lines.

The total length of the sewage network was 983 mts. The total number of manholes required was 53.

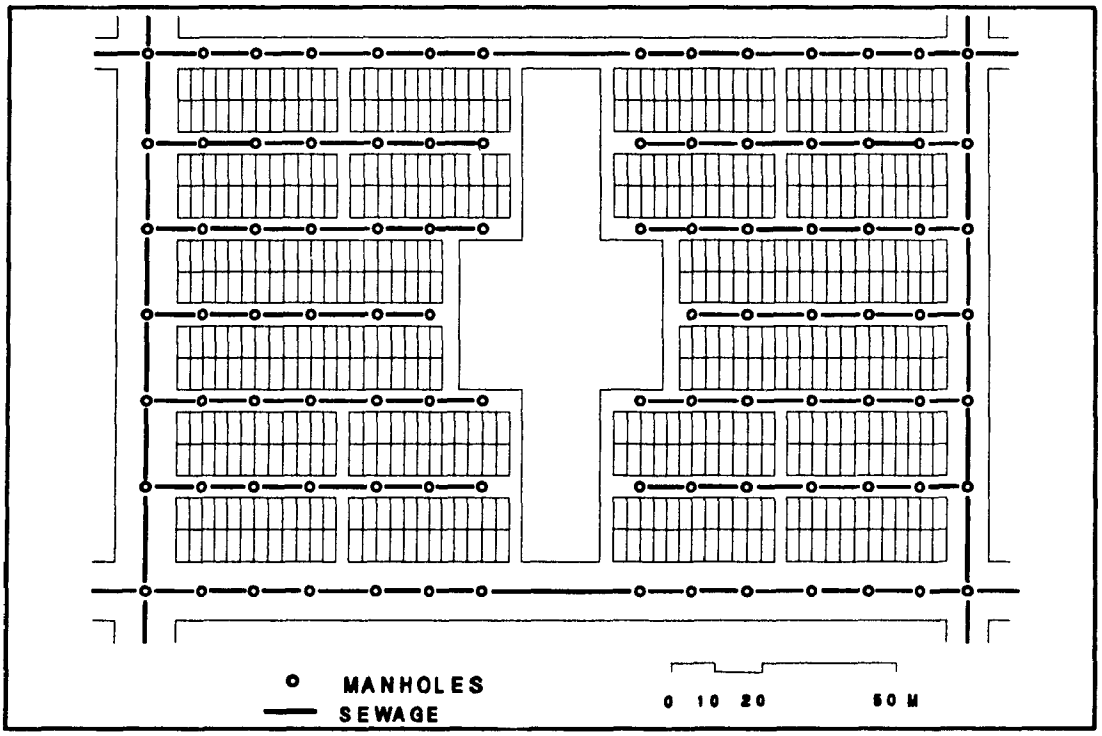

FIGURE NO.14 - SEWAGE DISPOSAL - CONTROL PLAN

1.2.3 Electricity

a. As illustrated in figure No.15, the neighbourhood was divided into 4 circuits. Each circuit had one transformer of 150 KVA serving approximately 25% of the plots. The average consumption per plot was estimated at 1 KVA.

b. The maximum distance for individual connections was 30 mts.

c. Priority was given for lamps to be installed at street intersections.

The total length of the electricity network was 933 mts. The number of poles and street lamps required was of 44 units.

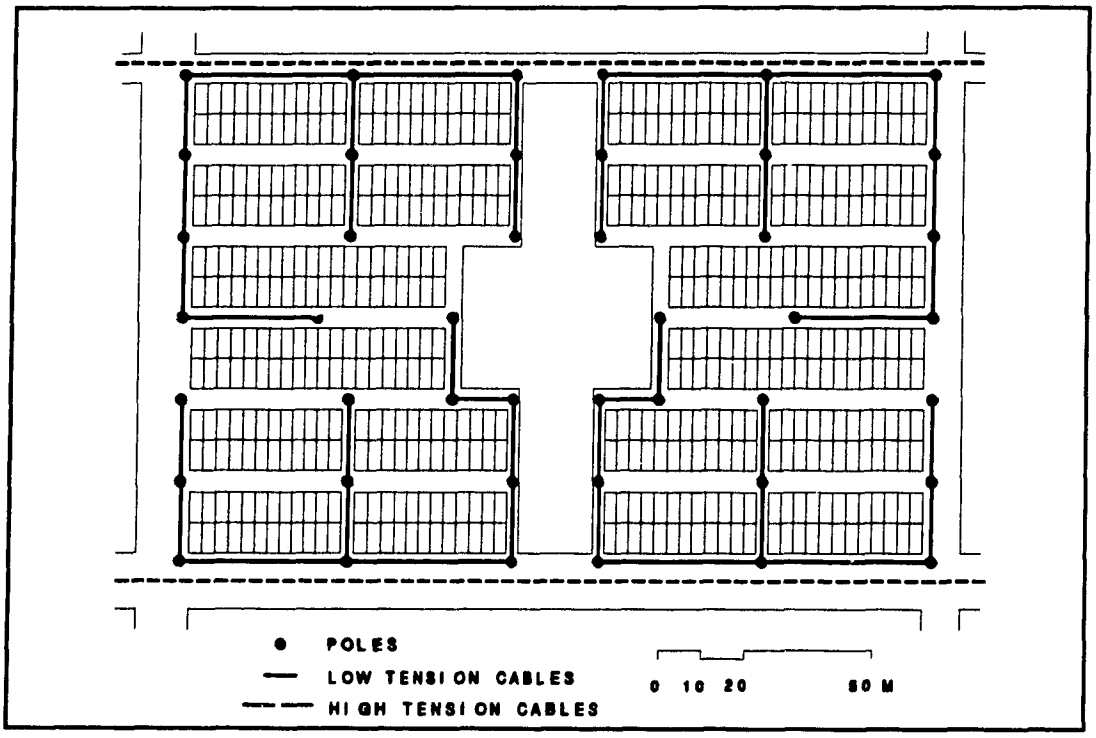

FIGURE No.15 - ELECTRICITY - CONTROL PLAN

1.2.4 Street Paving

a. As shown in figure No.16, all the streets in the control plan were to be fully paved given that these were strictly designed as circulation channels.

The total area to be paved was 3,360 M2.

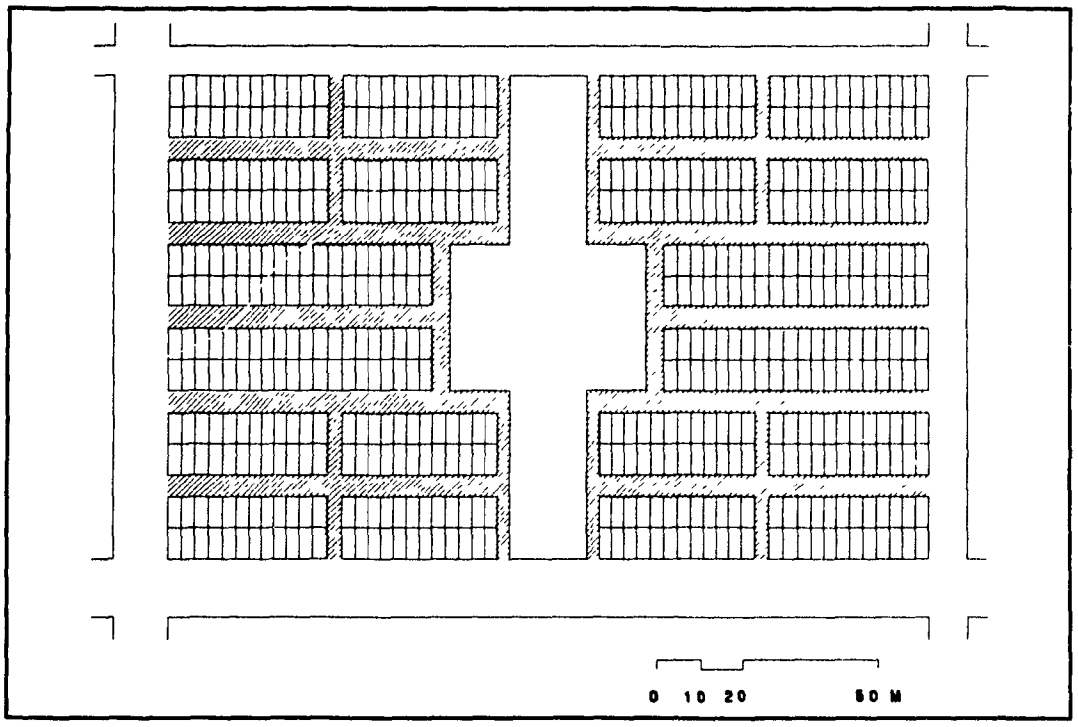

FIGURE NO.16 - STREET PAVING - CONTROL PLAN

Summary

The following material summarizes the performance of the control plan with regard to infrastructure efficiency:

Water supply	1,333 mts
Sewage disposal	983 mts
Number of manholes	53 u.
Electricity	933 mts
Poles/street lamps	44 u.
Paving	3,360 mts

2. DESIGN ALTERNATIVE # 1

The principal concern in this first design was the improvement of the environmental quality of the neighbourhood through the use of the

guidelines. In this case, no observations were made regarding infrastructure efficiency. The neighbourhood plan, seen in figure No.17, was structured around a series of **self-contained clusters**, each one having its own small square.

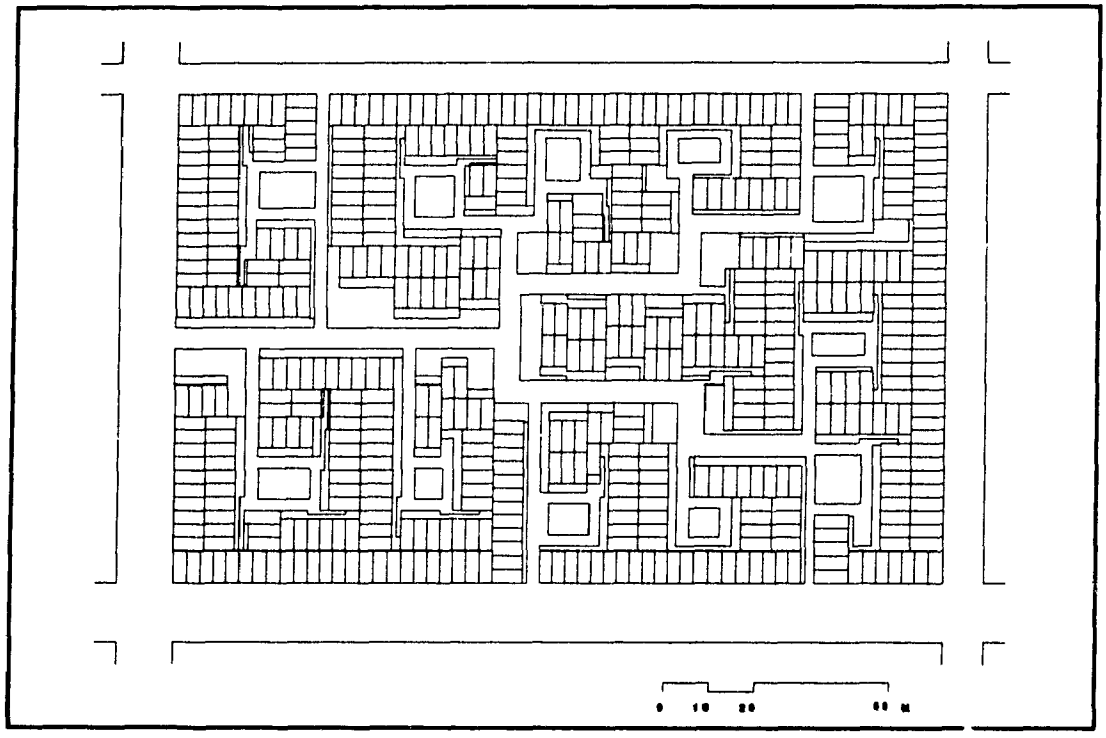

FIGURE No.17 - PLOT LAYOUT - ALTERNATIVE # 1

2.1 Land-Use

a. The total circulation areas were 3,519 M2. These areas, shown in figure No.18, accounted for 18.55% of the total site area.

b. The total area for public open spaces, illustrated in figure No.19, was 2,265 M2 which accounted for 11.94% of the total site area.

c. The public areas left for house extensions, shown in figure No.20, were 1,758 M2 which accounted for 9.26%.

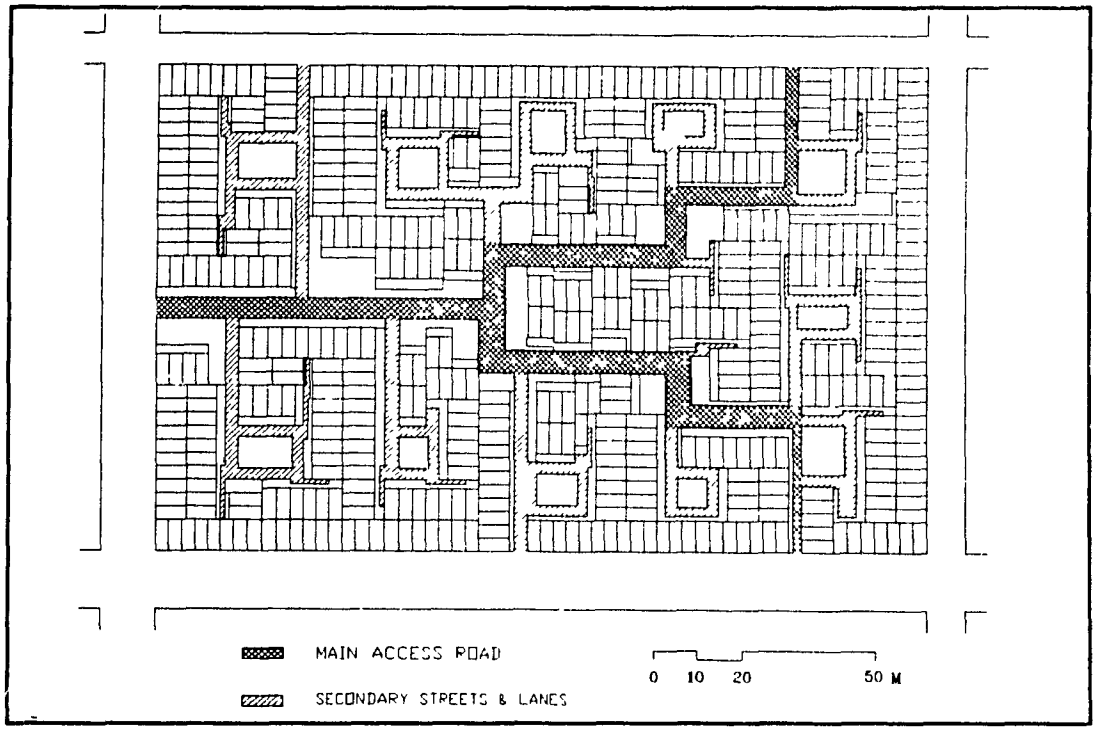

FIGURE NO.18 - CIRCULATION - ALTERNATIVE # 1

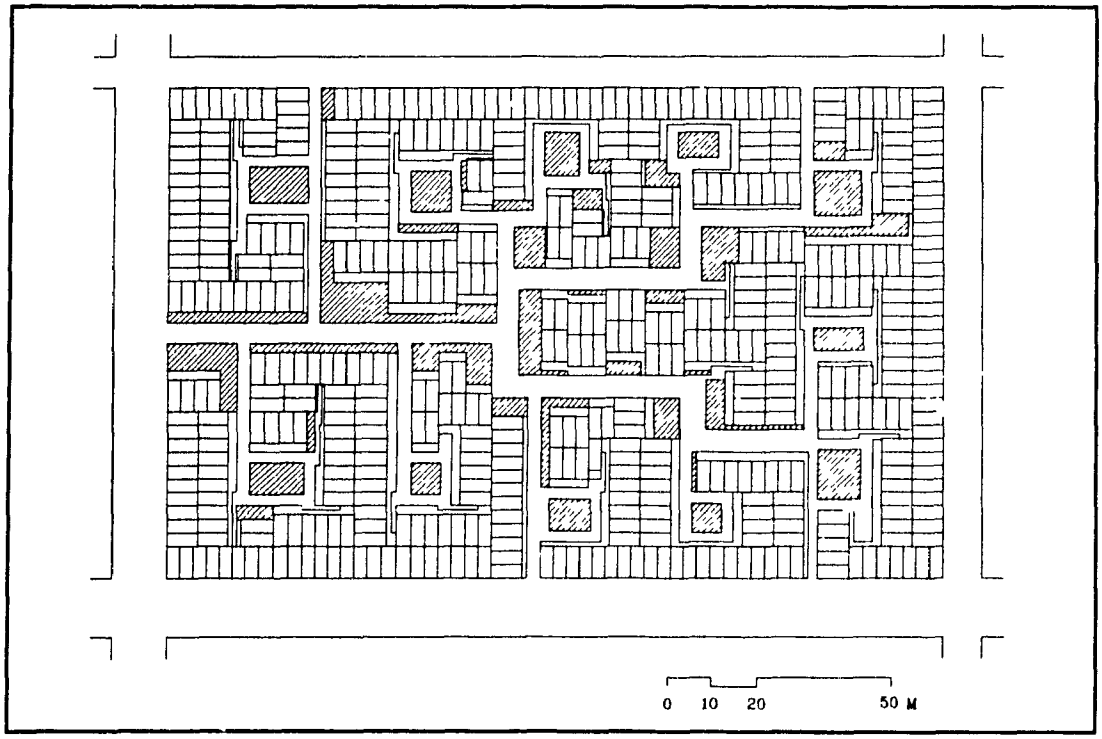

FIGURE NO.19 - PUBLIC OPEN SPACES - ALTERNATIVE # 1

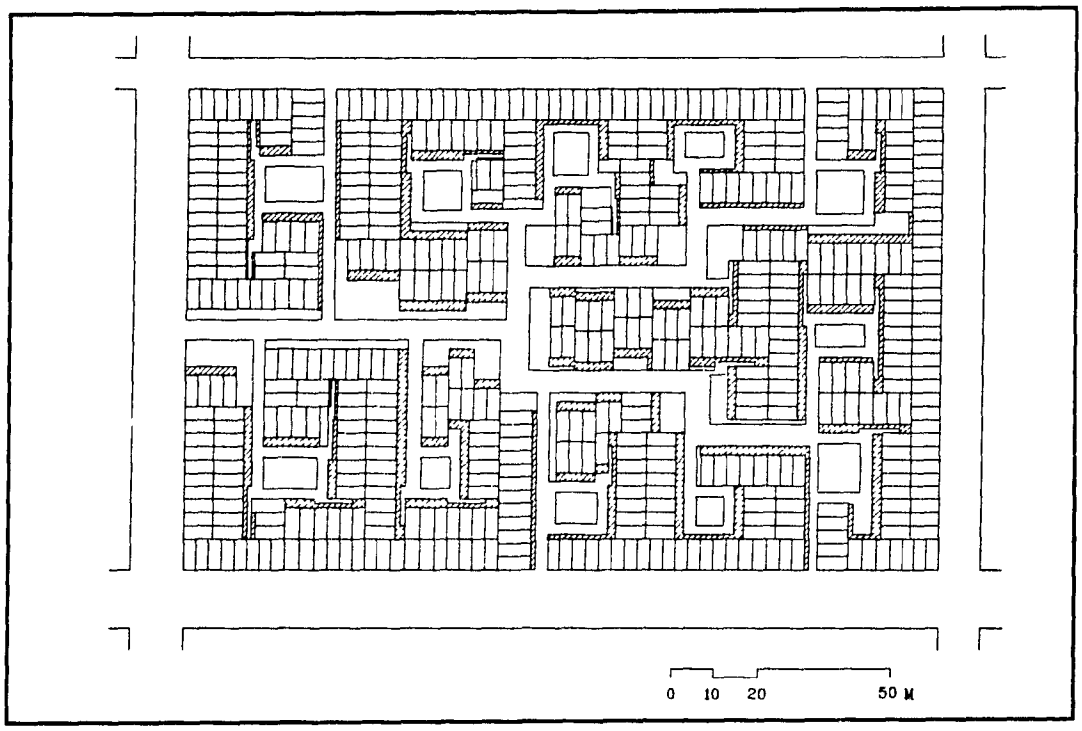

FIGURE No.20 - HOUSE EXTENSIONS - ALTERNATIVE # 1

d. The total private areas, illustrated in figure No.21, remained constant.

Summary

	M2	% of total site area
Circulation areas	3,519	18.55%
Public open spaces	2,265	11.94%
Area of house extensions	1,758	9.26%
Private area (k)	11,424	60.23%

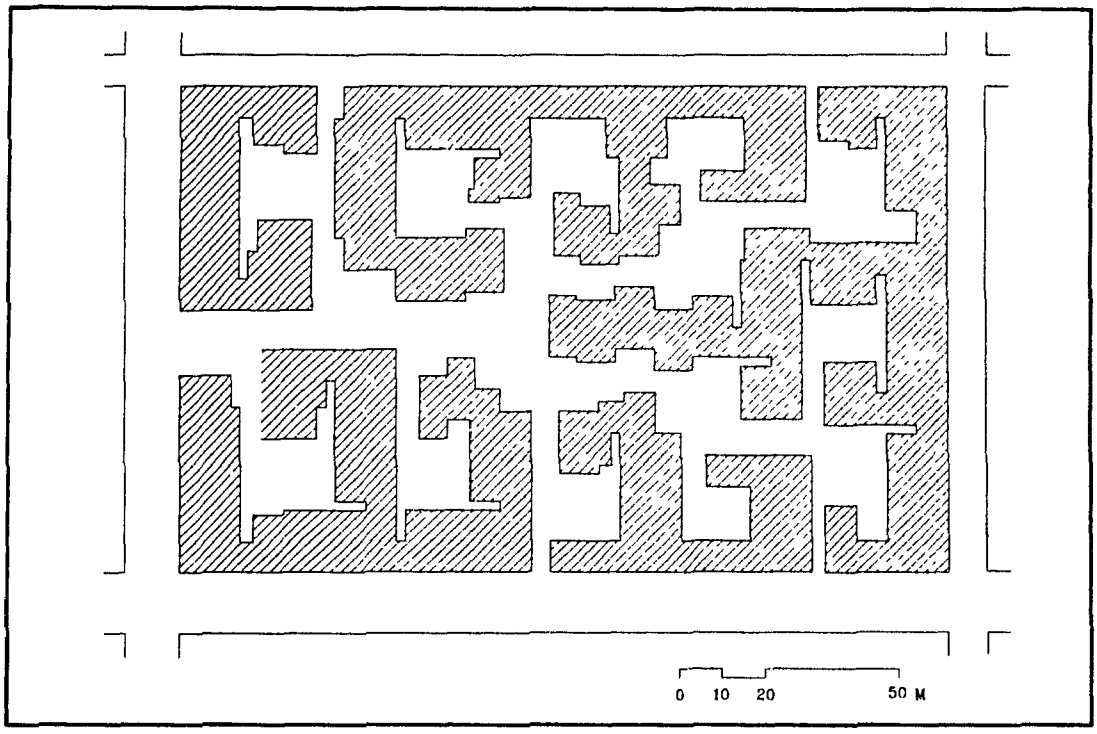

FIGURE NO.21 - PRIVATE AREAS - ALTERNATIVE # 1

Analysis

1. This first design alternative showed a significant reduction in the total circulation areas, as illustrated in figure No.22. In this case, a decrease of 24.4% was achieved over the control plan.
2. Areas for public open spaces decreased by 21.5%, as illustrated in figure No.23. However, despite this reduction, and based on the spatial characteristics and the location of the open spaces in design alternative # 1, it is considered that the use value of the land of these spaces would be higher than the use value of the central open space in the control plan.
3. Areas for house extensions, which are not provided in the control plan, accounted for 1,758 M2, as seen in figure No.24.

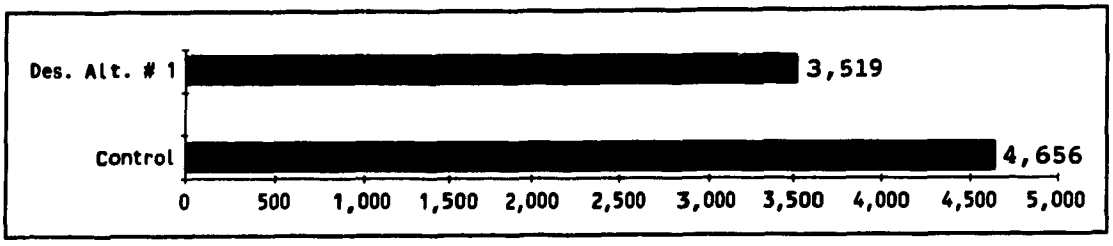

FIGURE No.22 - COMPARISON OF CIRCULATION AREAS

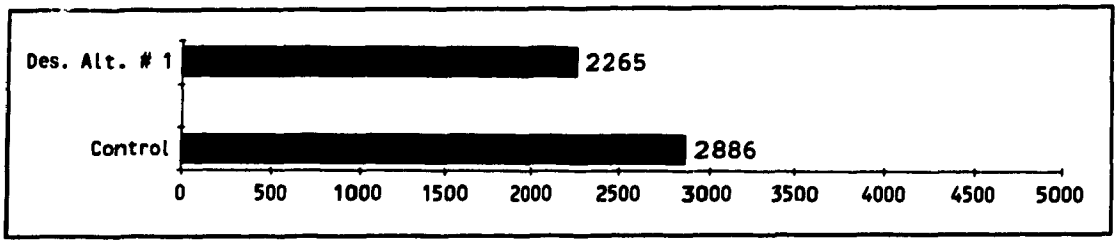

FIGURE No.23 - COMPARISON OF PUBLIC OPEN AREAS

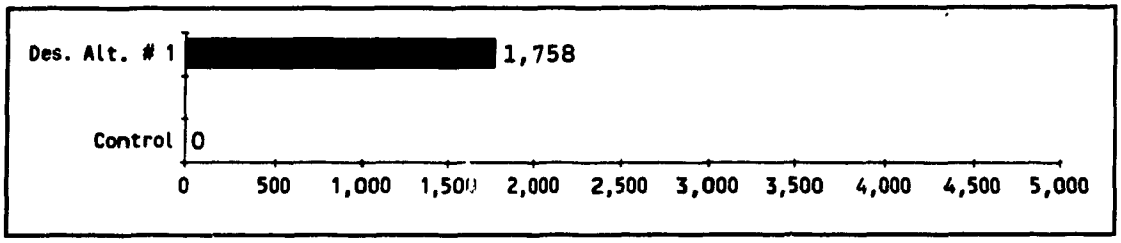

FIGURE No.24 - COMPARISON OF AREAS FOR HOUSE EXTENSIONS

2.2 Infrastructure Efficiency

The next step after determining land-use percentages was to design and measure the infrastructure networks. In this alternative, no assumptions were made regarding infrastructure efficiency. The design considerations and the results obtained for each service network were:

2.2.1 Water Supply

The main design considerations for the design of water supply lines, seen in figure No.25, were:

1. Connections to the main water supply lines, running along the neighbourhood's periphery, were provided at each intersection between a neighbourhood street and a peripheral street.
2. The primary water supply lines within the neighbourhood were laid out along the access road, and secondary streets intersecting peripheral streets.
3. Each self-contained cluster was serviced by a single branch derived from a primary line.

The total length of the water supply lines was of 1,382 mts.

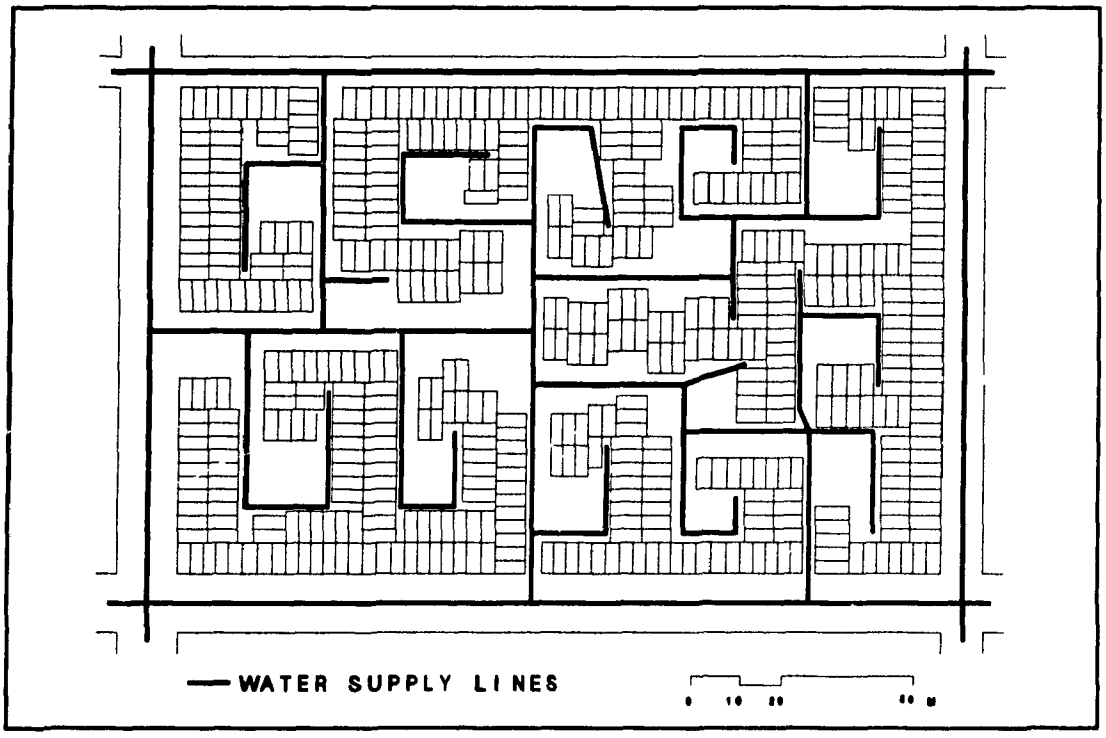

FIGURE NO.25 - WATER SUPPLY - ALTERNATIVE # 1

2.2.2 Sewage Disposal

Design considerations for the sewage disposal system, shown in figure No.26, were:

1. The primary collection lines were laid out along the access road.
2. Due to the physical configuration of the neighbourhood, each self contained cluster had to be served individually.
3. Spacing between manholes was set at a maximum distance of 18 mts, so that an average of 6 plots on either side of the street were connected to a single manhole.

The total length of the sewage network was 1,237 mts. The total number of manholes was 78 units.

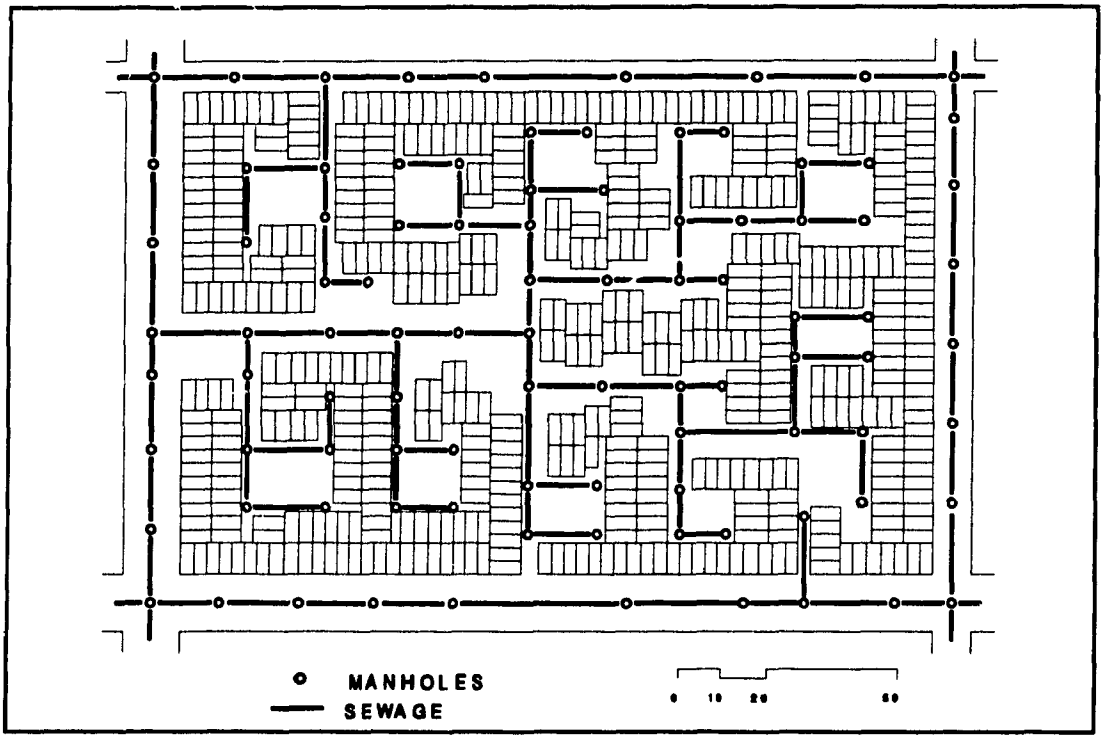

FIGURE NO.26 - SEWAGE DISPOSAL SYSTEM - ALTERNATIVE # 1

2.2.3 Electricity

Design considerations for electricity lines, shown in fig. No.27, were:

1. The neighbourhood was divided into 4 circuits, each serving approximately 25% of the plots. Every circuit was served by one transformer of 150 KVA. The capacity of the transformer was calculated on an average consumption of 1 KVA per plot.
2. The maximum distance for individual connections was 30 mts.
3. Lamps were to be installed primarily at streets intersections.

The total length of the electricity network was of 1,180 mts. The number of poles and street lamps required was 55 units.

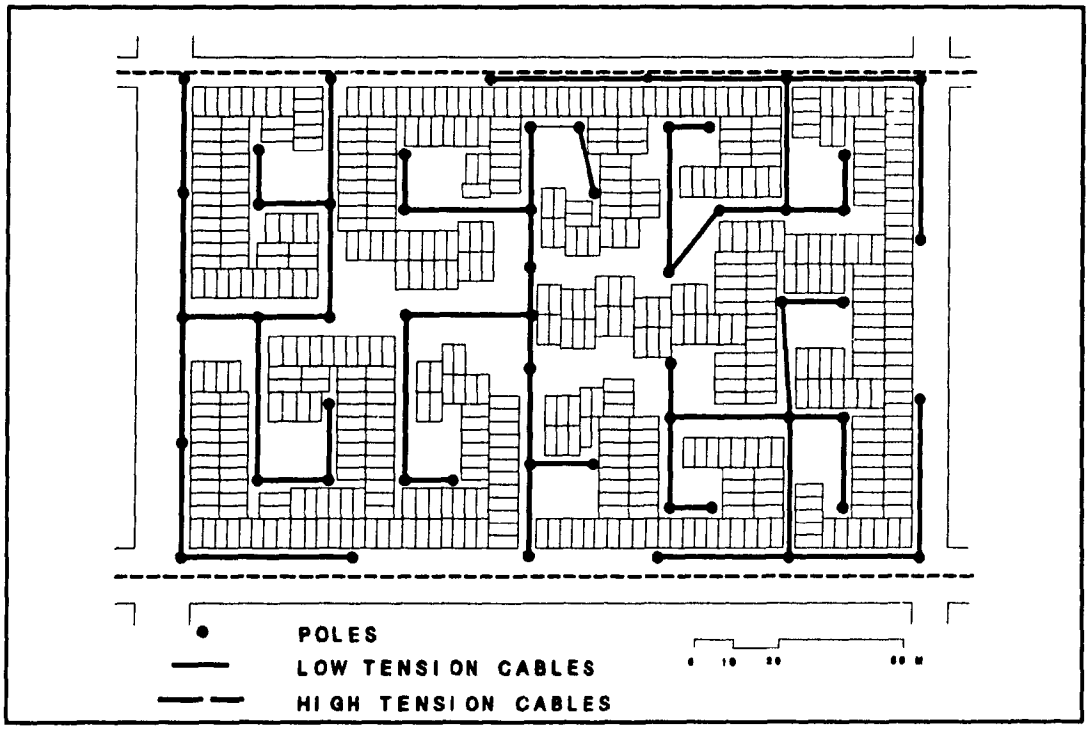

FIGURE NO.27 - ELECTRICITY - ALTERNATIVE # 1

2.2.4 Street Paving

Areas to be paved, illustrated in figure No.28, were:

1. The portions of the street assigned for circulation in the access road, and in secondary streets connecting the neighbourhood to the main peripheral roads.
2. The portions assigned for circulation in all small streets from their intersection with the access road to their intersection with a small square of a self-contained cluster.

The total area to be paved was 2,150 M2.

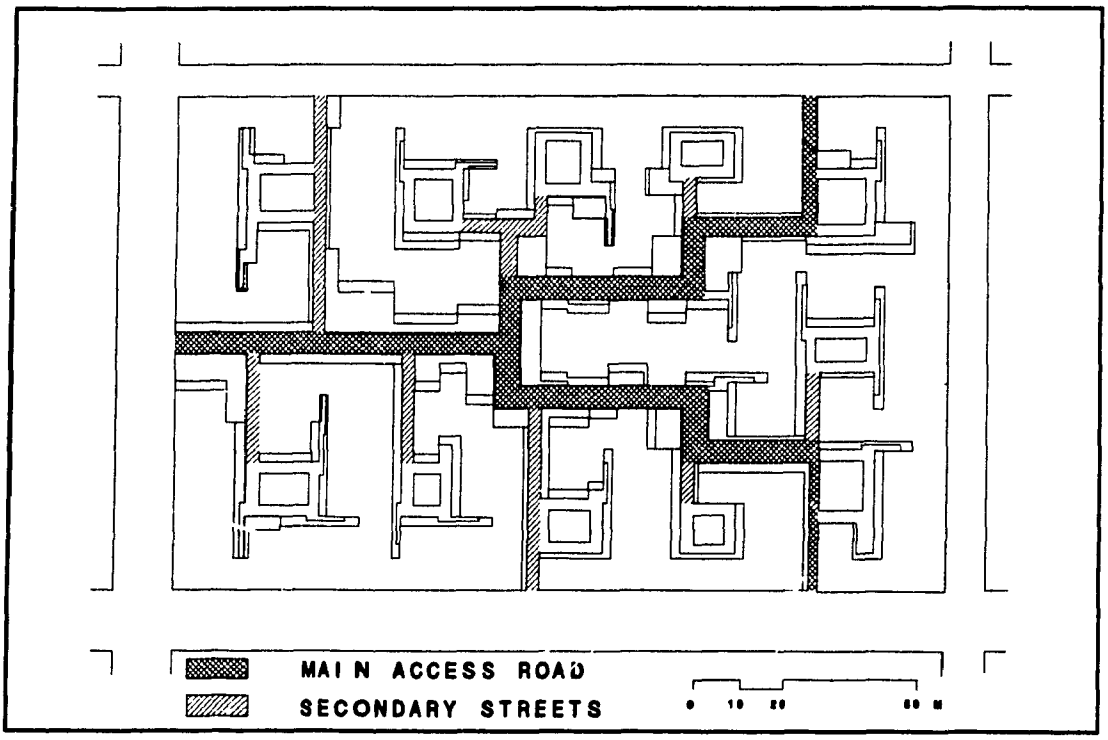

FIGURE NO.28 - STREET PAVING - ALTERNATIVE # 1

Summary

The following material presents the performance regarding infrastructure efficiency of design alternative No.1:

Water supply 1,382 mts

Sewage disposal	1,237 mts
Number of manholes	78 u.
Electricity	1,180 mts
Poles/street lamps	55 u.
Paving	2,150 M2

Analysis

Since the main concern in this first design was to produce a plan based on the use of the guidelines no considerations were given to infrastructure efficiency. Thus, the results achieved showed in some instances an increase in quantities of infrastructure when compared to those attained in the control plan. For example, penalties were paid in the total length of sewers and in the number of manholes, as well as in the total length of the electrical lines. Water supply proved to be the same, while percentage of paved areas decreased substantially. The detailed results achieved for each service network were:

1. The water supply network, seen in figure No.29, showed a very small increase over the control plan; from 1,333 mts to 1,382 mts. This difference represented an increment almost negligible: only 3.6%.
2. The total length of the sewerage network, seen in figure No.30, increased by 254 mts. This amount represented a increment of 25.8% over the control plan.
3. The number of manholes augmented, as illustrated in figure No.31, from 53 in the control plan to 78 in the new design alternative. This difference represented an increase of 47.16%.
4. The length of the electricity network increased by 26.47%, as

illustrated in figure No.32.

5. The number of poles and street lamps went up from 44 units in the control plan to 55 units in design alternative # 2, as illustrated in figure No.33. This difference represented an increment of 25%.
6. Street paving was the only infrastructure service which substantially decreased with regard to the control plan, as illustrated in figure No.34. The net reduction in this case was 40.27%.

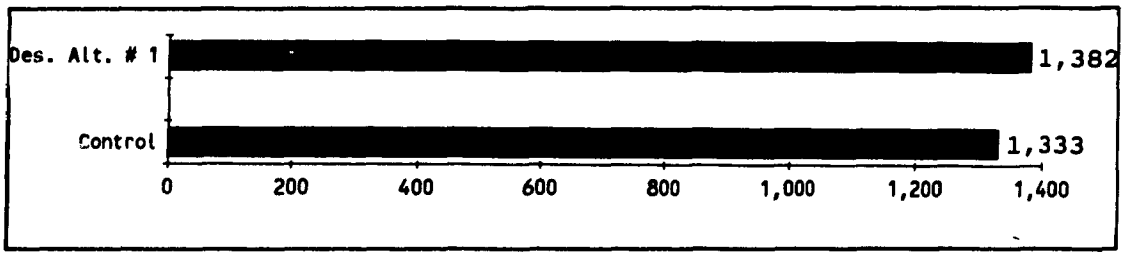

FIGURE No.29 - COMPARISON OF TOTAL LENGTH OF WATER SUPPLY NETWORKS

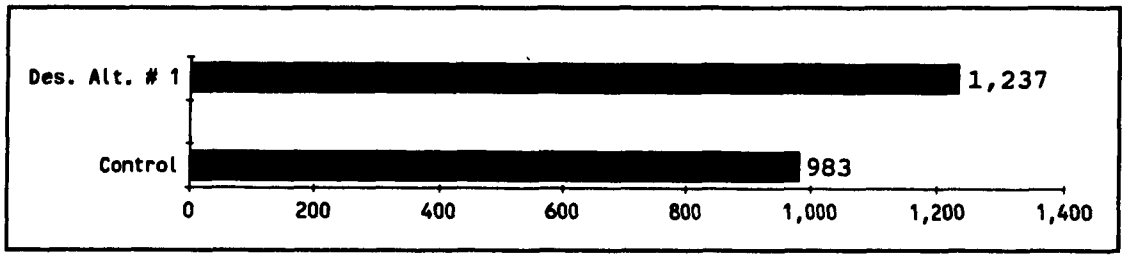

FIGURE No.30 - COMPARISON OF TOTAL LENGTH OF SEWERAGE NETWORKS

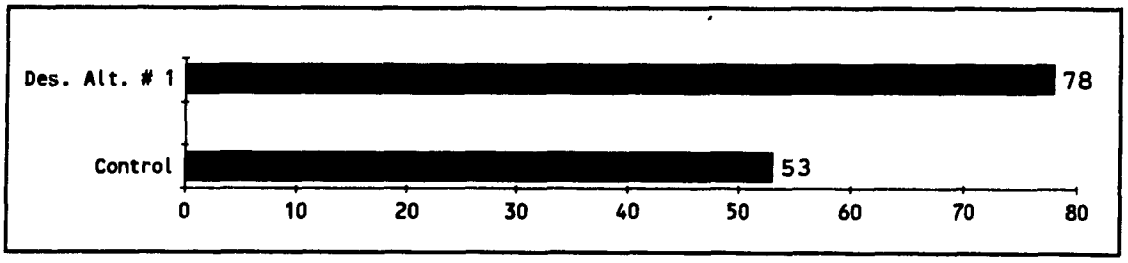

FIGURE No.31 - COMPARISON OF TOTAL NUMBER OF MANHOLES

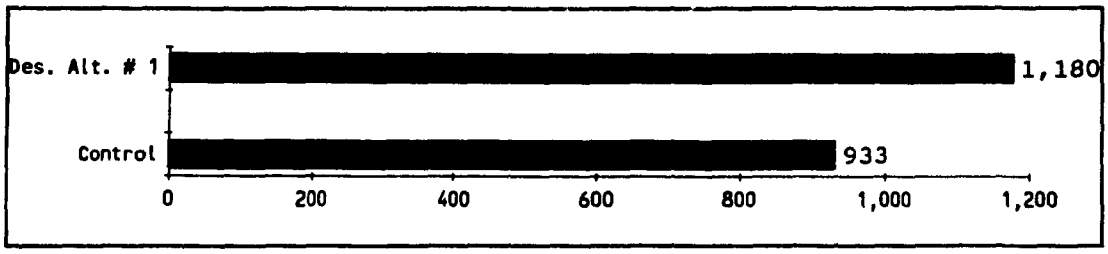

FIGURE NO.32 - COMPARISON OF TOTAL LENGTH OF ELECTRICITY NETWORKS

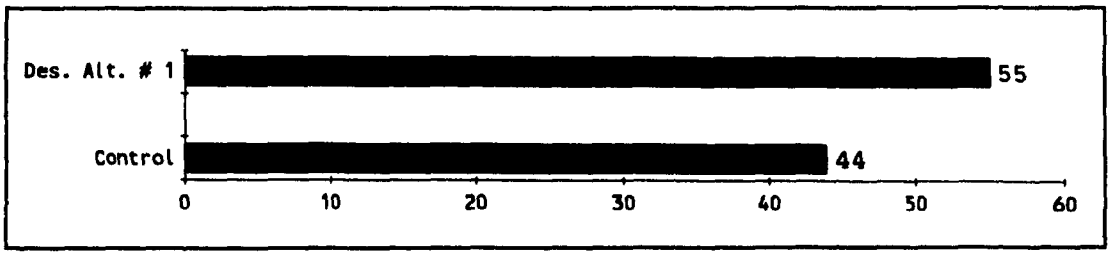

FIGURE NO.33 - COMPARISON OF TOTAL NUMBER OF POLES AND STREET LAMPS

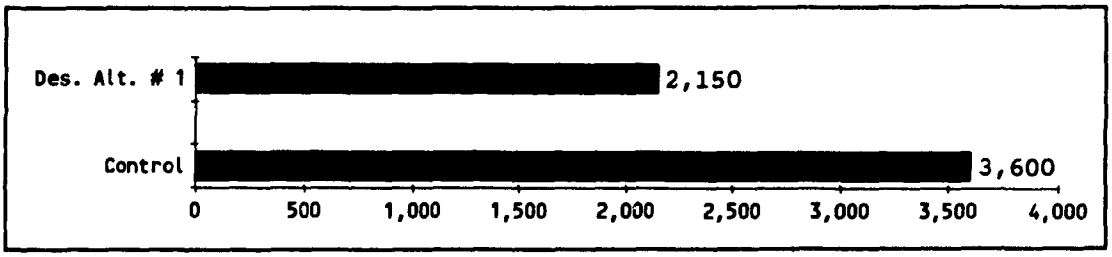

FIGURE NO.34 - COMPARISON OF PAVED AREAS

3. DESIGN ALTERNATIVE # 2

The use of self-contained clusters in design alternative # 1, illustrated in figure No.35, were believed to be the cause for the increase in length of sewage and number of manholes. It was then felt that by interconnecting the clusters, as seen in figure No.36, and by reducing the number of turns a more efficient infrastructure network could be achieved.

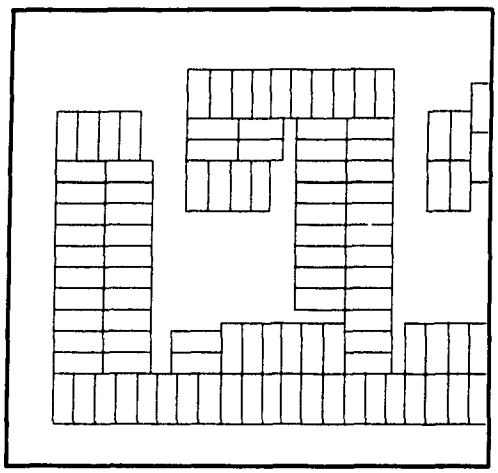

FIG No.35 - SELF-CONTAINED CLUSTER

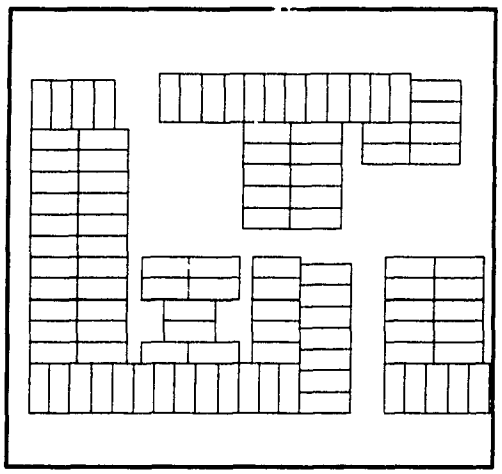

FIG No.36 - INTERCONNECTED CLUSTER

In this second case, the neighbourhood was designed as a series of **interconnected clusters.** Each cluster was organized around a small square which varied in size and in shape according to location, as illustrated in figure No.37.

3.1 Land-Use

Land-use areas showed the following results:

a. The total circulation areas were of 4,164 M2. These areas shown in figure No.38, accounted for 21.95% of the total site area.

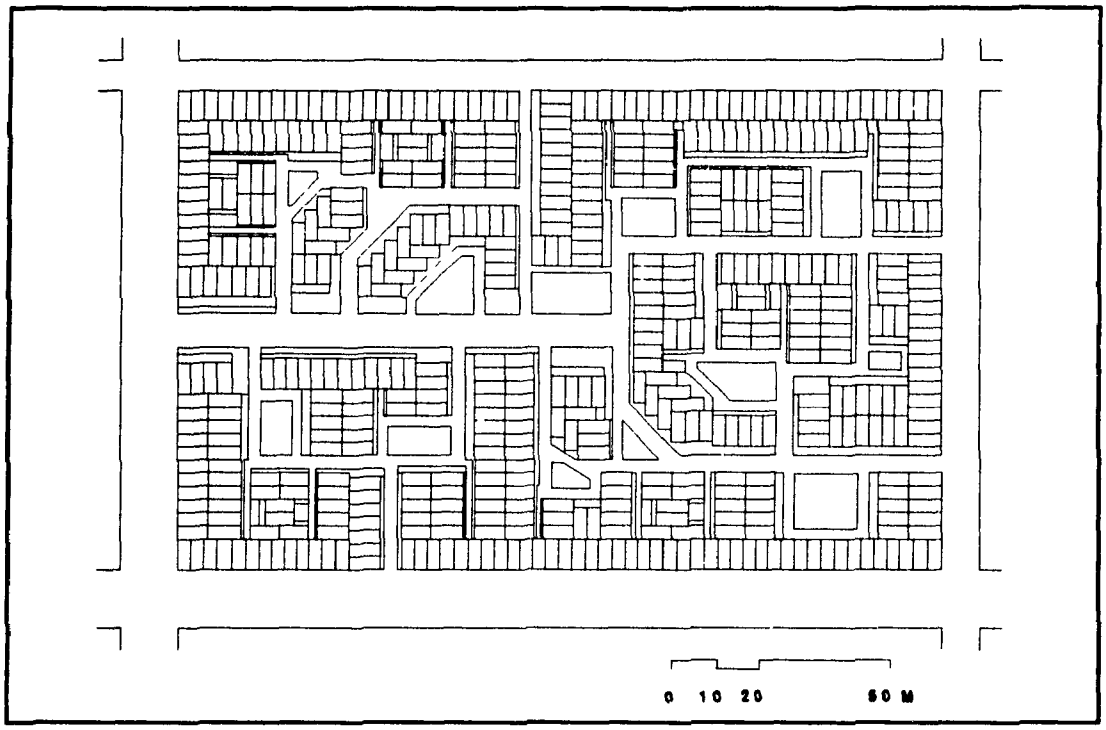

FIGURE NO.37 - PLOT LAYOUT - ALTERNATIVE # 2

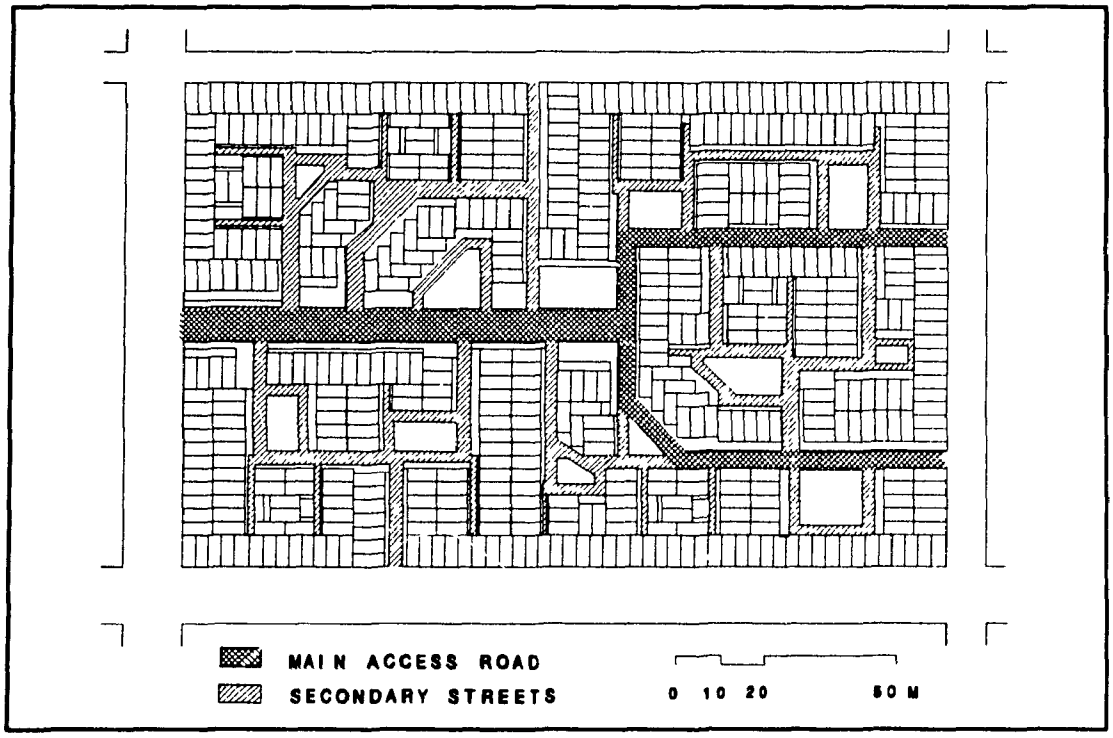

FIGURE NO.38 - CIRCULATION - ALTERNATIVE # 2

b. The total area left for public open spaces, illustrated in figure No.39, was 1,884 M2 which accounted for 9.93% of the total site area.

c. The total areas left for house extensions, shown in figure No.40, were 1,494 M2. These areas accounted for 7.87% of the total site area.

d. The total private areas, shown in figure No.41, remained constant.

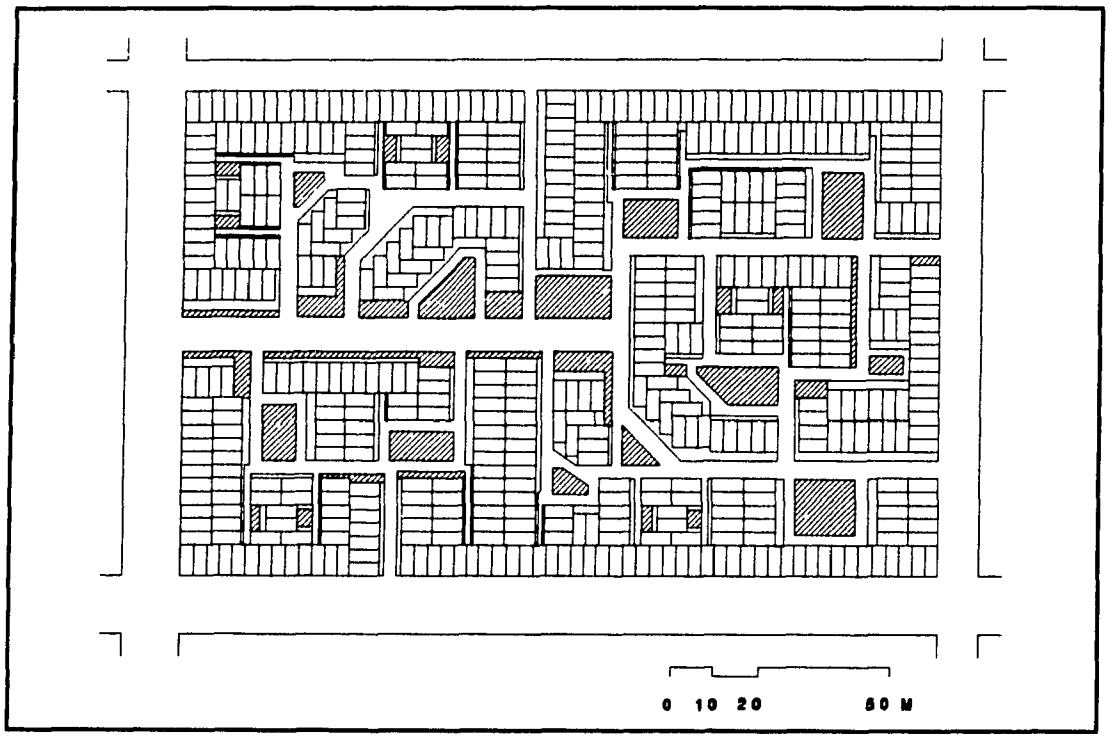

FIGURE NO.39 - PUBLIC OPEN SPACES - ALTERNATIVE # 2

Summary

	M2	% of total site area
Circulation areas	4,164	21.95%
Public open spaces	1,884	9.93%
House extensions	1,494	7.87%

Private area (k)	11,424	60.25%
Total	18,966	100%

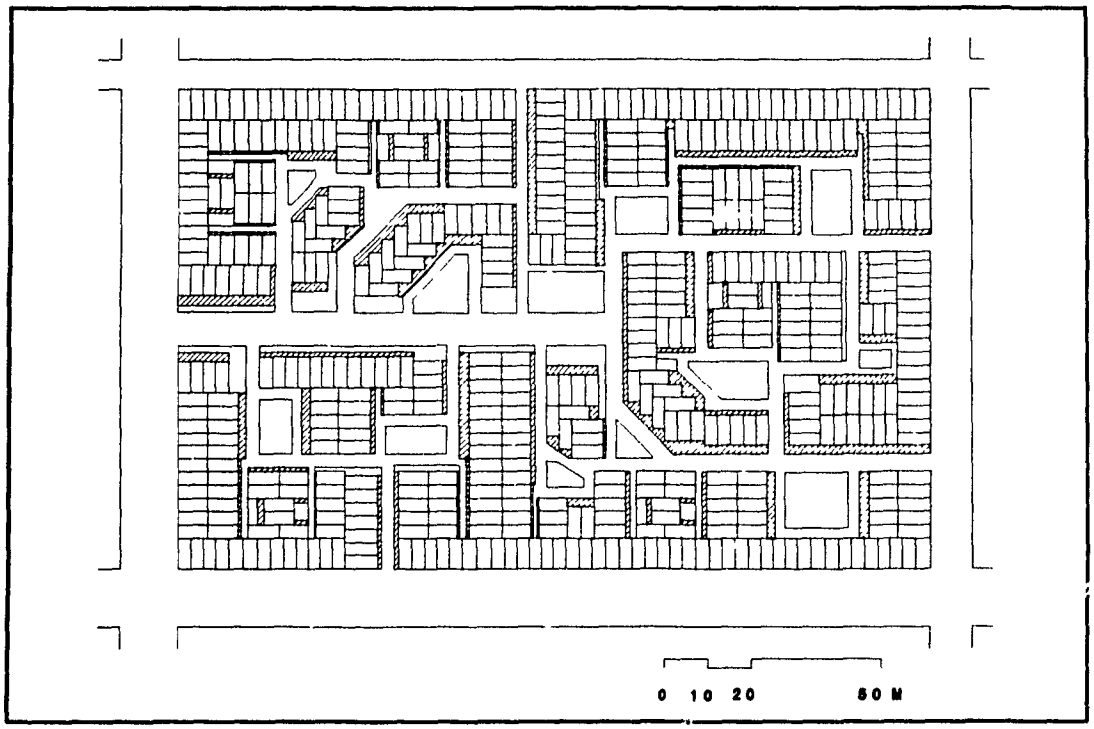

FIGURE NO.40 - HOUSE EXTENSIONS - ALTERNATIVE # 2

Analysis

This second neighbourhood plan paid penalties in all the three land use variables: circulation, public open spaces, and house extensions, with respect to design alternative # 1. However, alternative # 2 was more efficient than the control plan, despite a reduction in the total public open areas. From the results obtained it is possible to observe that:

1. The total circulation areas decreased by 10.56% in reference to the control plan, as illustrated in figure No.42. Design alternative # 2, however, was less efficient than alternative # 1. In this case,

circulation areas increased by 15.49%.

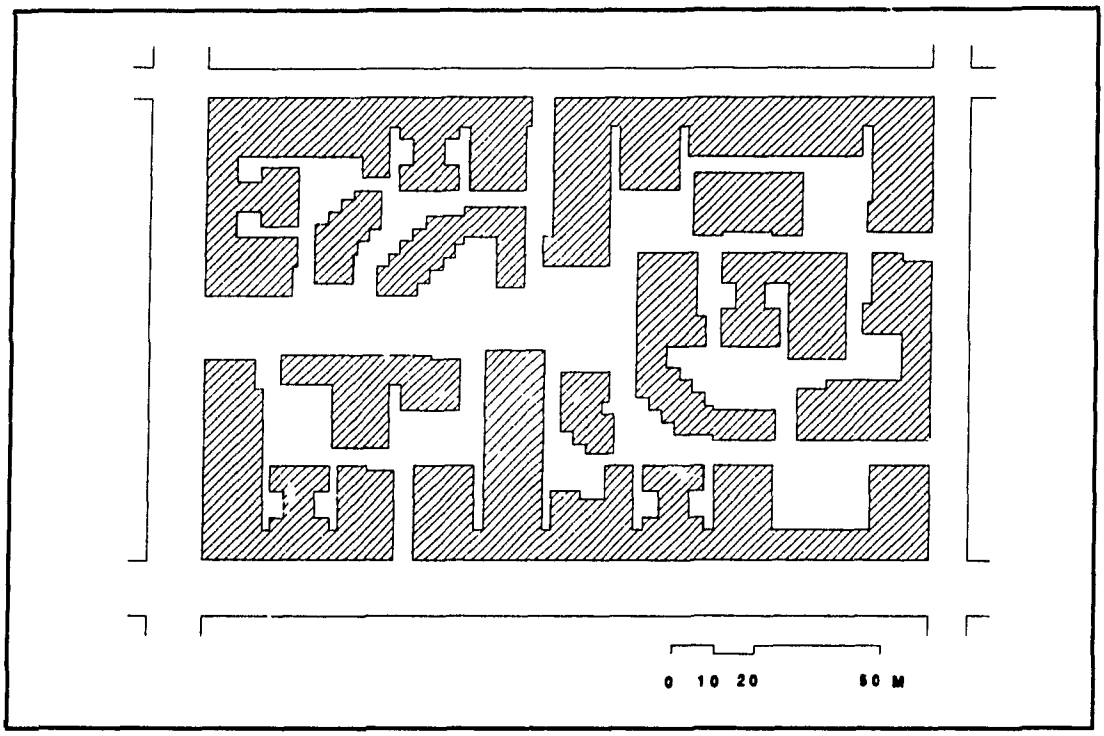

FIGURE NO.41 - PRIVATE AREAS - ALTERNATIVE # 2

2. In reference to public spaces, this second design alternative was the least efficient of the three neighbourhood plans under consideration. In this new option areas for public open spaces dropped by 34.72% against the control plan, and by 16.82% against design alternative # 1, as seen in figure No.43.
3. The total area for house extensions decreased by 15.01% in reference to design alternative # 1, as illustrated in figure No.44.

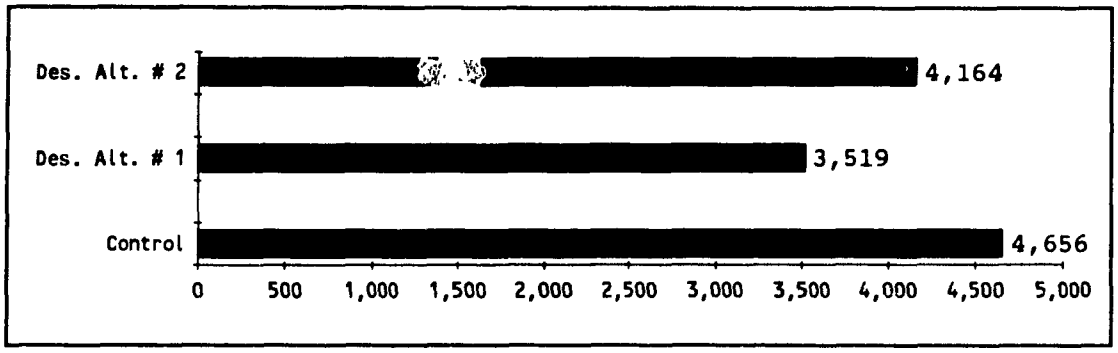

FIGURE NO.42 - COMPARISON OF CIRCULATION AREAS

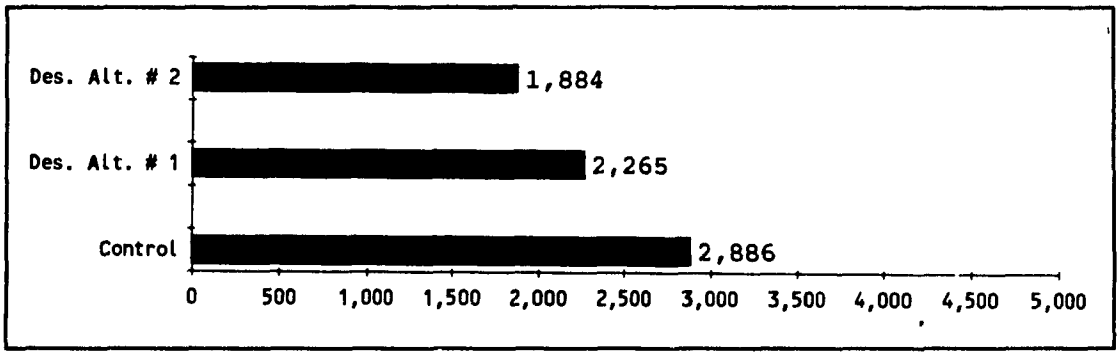

FIGURE NO.43 - COMPARISON OF PUBLIC OPEN AREAS

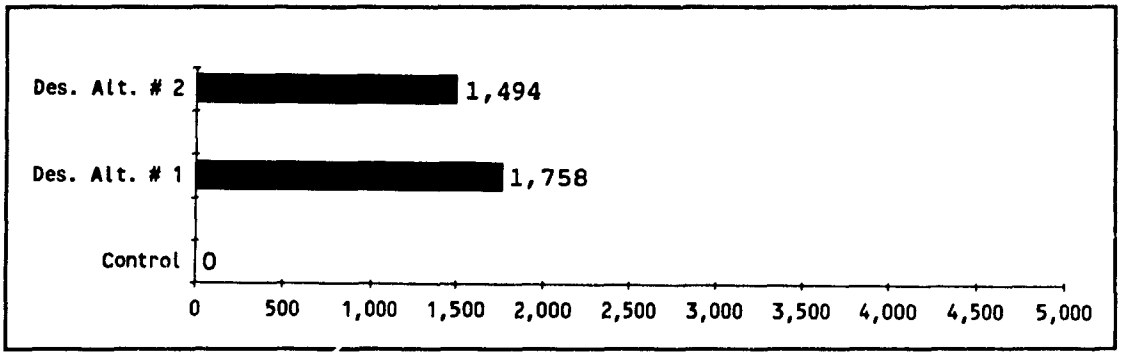

FIGURE NO.44 - COMPARISON OF AREAS FOR HOUSE EXTENSIONS

3.2 Infrastructure Efficiency

In design alternative # 1 the use of self-contained clusters was

felt to be the cause for the increase in quantities of infrastructure. Therefore, the second alternative, illustrated in figure No.37, was structured around a series of clusters which were internally connected through a network of secondary streets. In this case it was assumed that by having the potential to run lines from cluster to cluster, the number of turns required for laying out the service networks would be reduced, thus decreasing their total length. It was also felt that by doing so the total number of manholes and the number of poles and street lamps would be reduced. However, given the increase in circulation an increment in the total amount of paved areas was expected.

3.2.1 Water Supply

Design considerations for water supply network, shown in figure No.45, were:

1. Connections to the main peripheral water supply lines were provided at each intersection between a neighbourhood and a peripheral street.
2. Primary water supply lines within the neighbourhood were located along the access road.
3. Water supply lines serving individual clusters were provided through branches connected to the primary water lines running along the access road. These branches were interconnected through the secondary streets linking the clusters, thus overcoming the problem of having dead end lanes longer than 15 mts.

The total length of the water supply lines was of 1,443 mts.

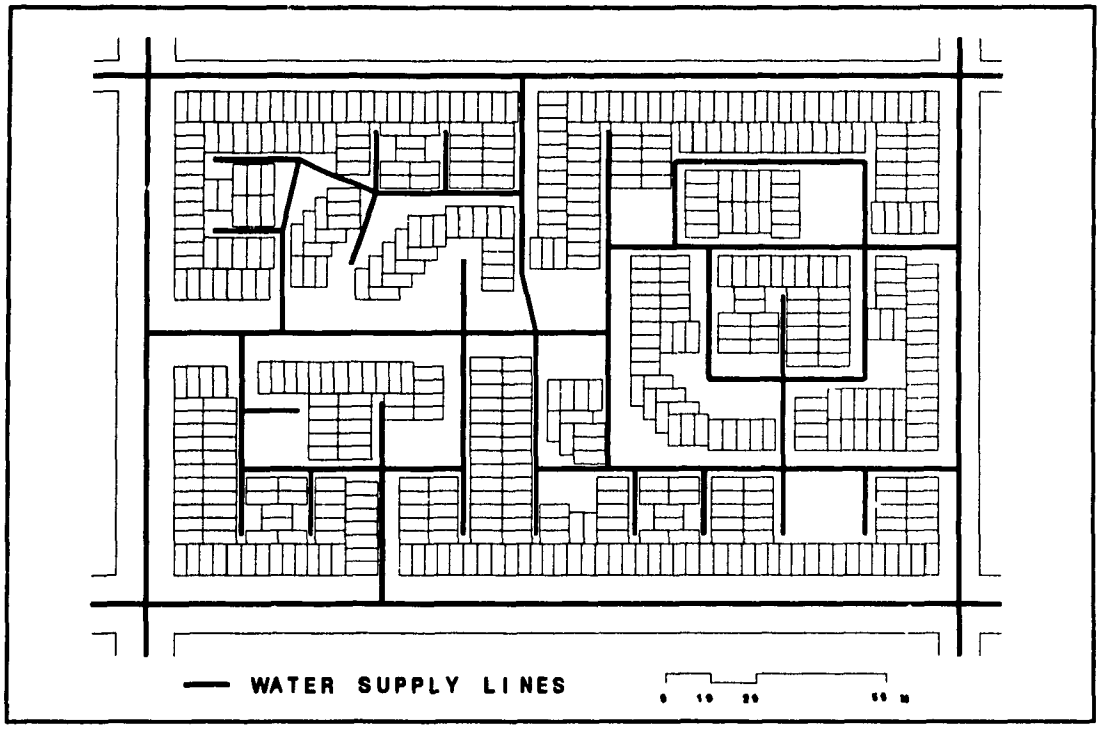

FIGURE NO.45 - WATER SUPPLY - ALTERNATIVE # 2

3.2.2 Sewage Disposal

Design considerations for the sewage network, seen in figure No.46, were:

1. The sewage network was subdivided into four different sectors, each serving roughly 25% of the neighbourhood. It was felt that by subdividing the neighbourhood into various sectors, the total length of sewers could be reduced.
2. Each sector was connected separately to the main peripheral sewage lines.
3. An average of six plots on either side of the street were connected to a single manhole. As a result, spacing for manholes was set at an average distance of 18 mts.

The total length of the sewage network was of 1,208 mts. The total number of manholes was of 75.

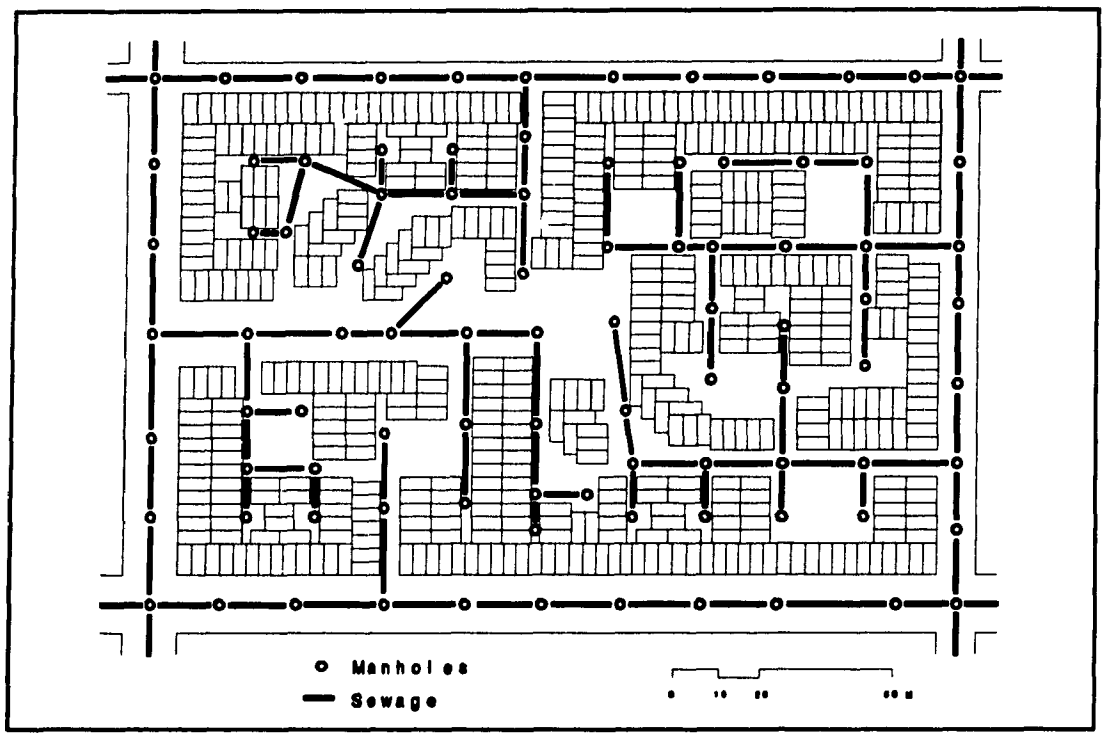

FIGURE No.46 - SEWAGE DISPOSAL - ALTERNATIVE # 2

3.2.3 Electricity

Design considerations for the electricity network, shown in figure No.47, were:

1. The network was subdivided into four different circuits each one servicing approximately 25% of the plots.
2. Individual drops were shorter than 30 mts.
3. Public lamps were located at street intersections and dead-end lanes.

The total length of the electricity network was of 1,082 mts. The number of poles and street lamps required was of 47.

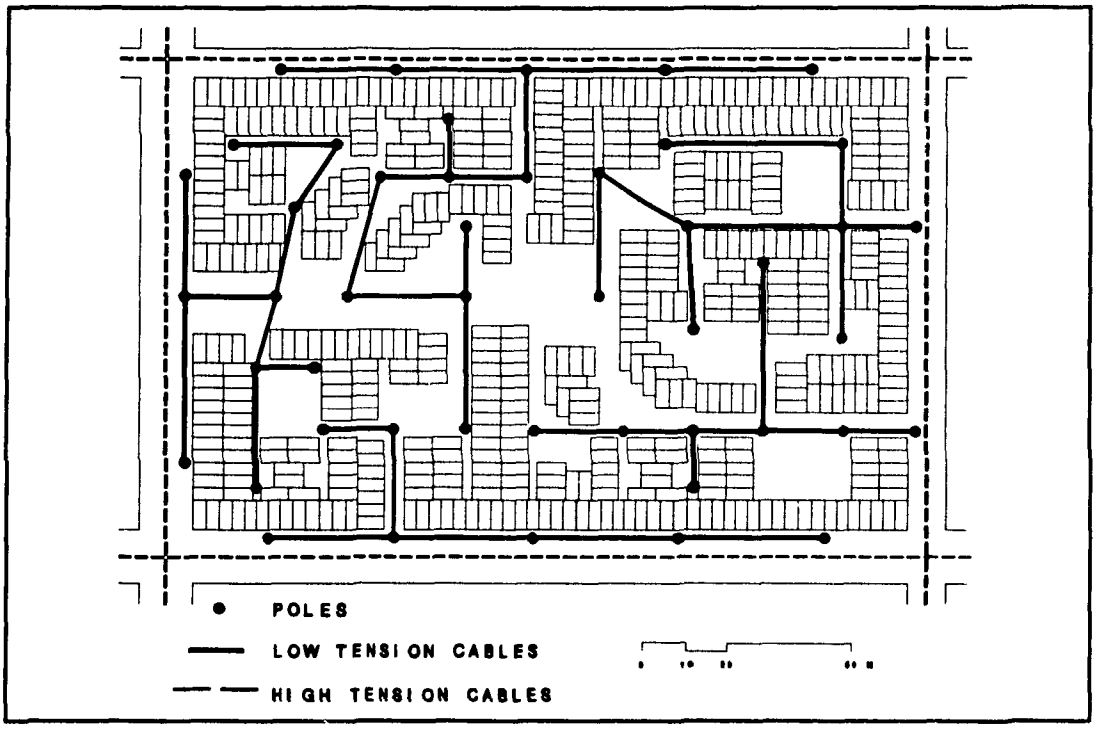

FIGURE No.47 - ELECTRICITY NETWORK - ALTERNATIVE # 2

3.2.4 Paving

Design considerations for street paving areas, illustrated in figure No.48, were:

1. The portions intended for circulation in the access road, as well as in the secondary streets connecting the neighbourhood to main peripheral roads were to be paved.
2. All small streets connecting the access road and ending in small squares were to be paved.
3. Small streets interconnecting clusters were left unpaved.
4. All dead-end lanes remained unpaved.

The total area to be paved was of 2,521 mts.

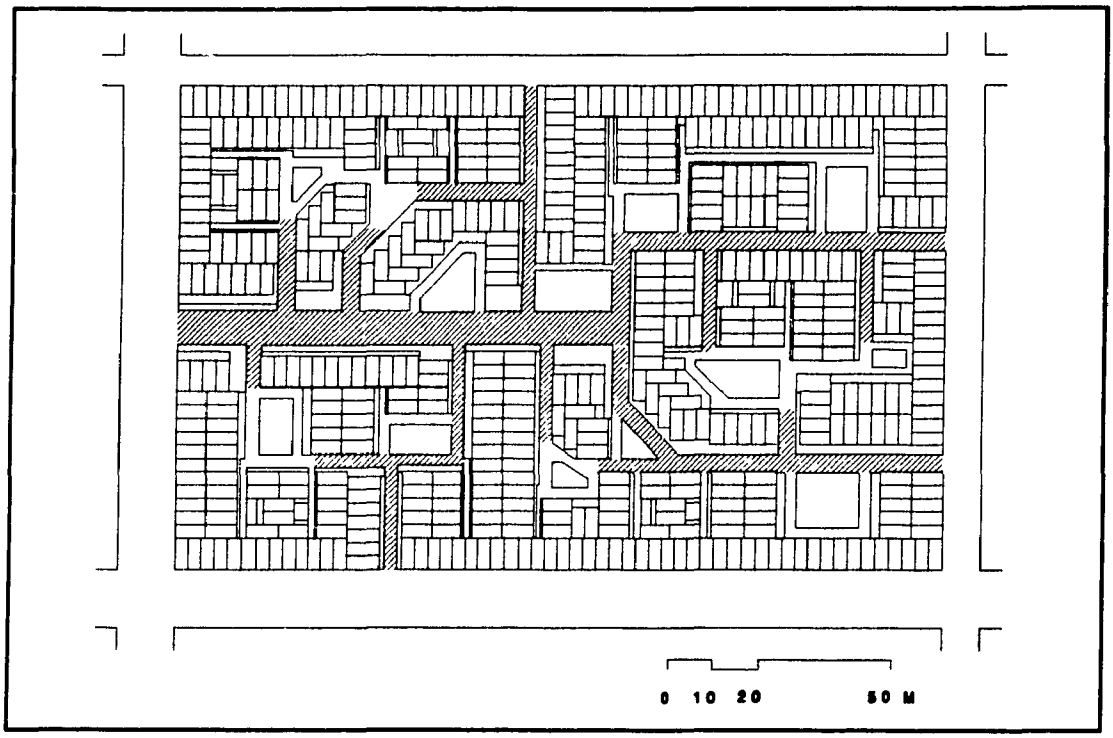

FIGURE NO.48 - STREET PAVING

Summary

Water supply	1,443 mts
Sewage disposal	1,208 mts
Number of manholes	75 u.
Electricity	1,082 mts
Poles/street lamps	47 u.
Paving	2,521 M2

Analysis

This neighbourhood plan evidenced a better performance than design alternative # 1. However, the gains made for infrastructure were very limited and did not compensate for the losses in the spatial quality of

the neighbourhood.

This second option showed a significant decrease in the length of the electrical lines and in the number of poles and street lamps in reference to design alternative # 1. A minor decrease in the length of sewers and in the number of manholes was also observed. The figures obtained, however, were still more greater than those reached in the control plan. Additionally, the total length of the water supply network increased against design alternative # 1 and the control plan. A detailed analysis of the results achieved for each service network is presented below.

1. The total length of the water supply network was higher than the quantities achieved in the control plan and in design alternative # 1, as illustrated in figure No.49. The increment was of 7.62% and 4.22% respectively.
2. Although the total length of the sewerage network was still much greater than the quantity obtained in the control plan, a minor reduction was possible with regard to design alternative # 1. In this case the length of sewage decreased by 2.34%, as shown in figure No.50. The net increment of design alternative 2 over the control plan was 18.62%.
3. The number of manholes was significantly higher than the quantity achieved in the control plan, despite a small reduction achieved over design alternative # 1. The number of manholes in design alternative # 2 augmented, as illustrated in figure No.51, by 29.33% over the control plan.
4. The total length of the electrical network increased by 13.77% over the control plan, as illustrated in figure No.52. On the other hand,

a reduction of 8.3% was achieved over design alternative # 2.

5. The number of poles and street lamps showed an increase of 6.38% against the control plan. Their total number, however, was reduced by 14.54% in reference to design alternative # 1, as illustrated in figure No.53.
6. Street paving in design alternative # 2 evidenced a reduction of 29.97% over the control plan. The total circulation areas in this case increased by 14.71% with regard to alternative # 1, as seen in figure No.54.

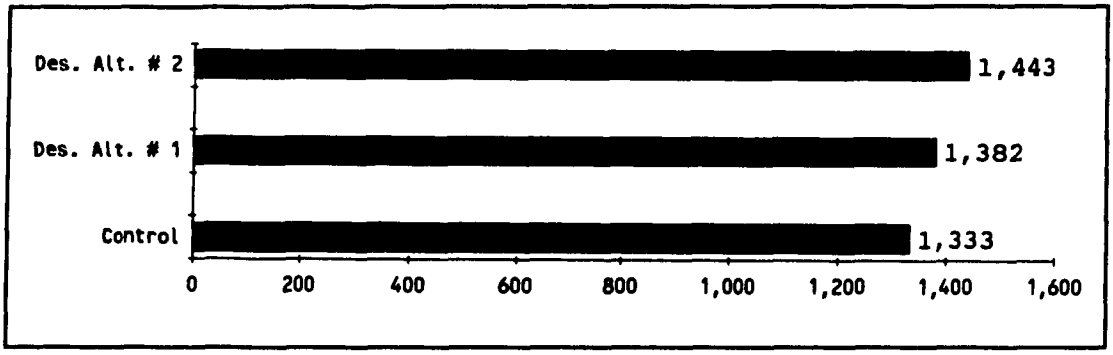

FIGURE NO.49 - COMPARISON OF TOTAL LENGTH OF WATER SUPPLY LINES

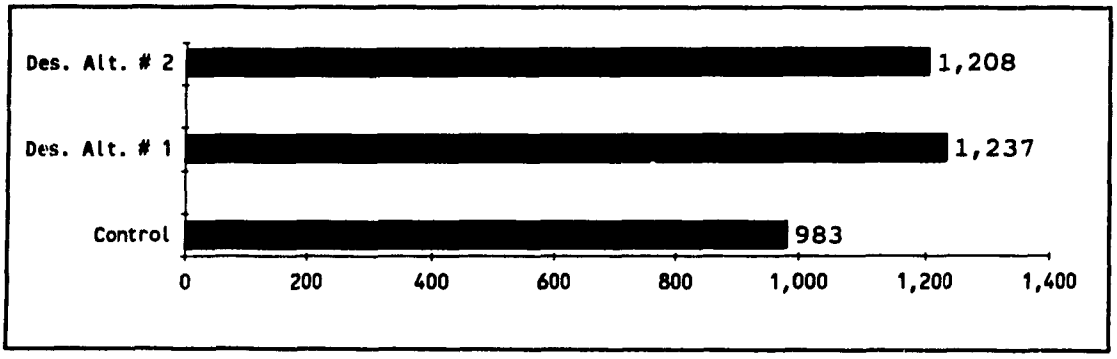

FIGURE NO.50 - COMPARISON OF TOTAL LENGTH OF SEWERAGE NETWORKS

FIGURE NO.51 - COMPARISON OF TOTAL NUMBER OF MANHOLES

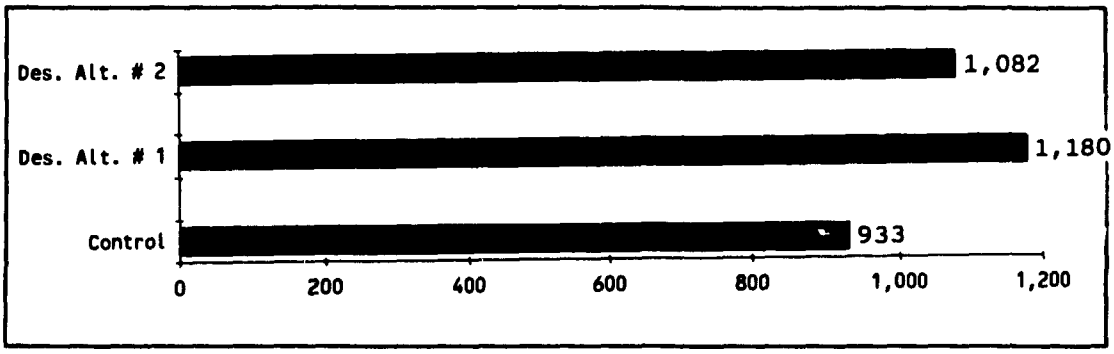

FIGURE NO.52 - COMPARISON OF TOTAL LENGTH OF ELECTRICITY NETWORKS

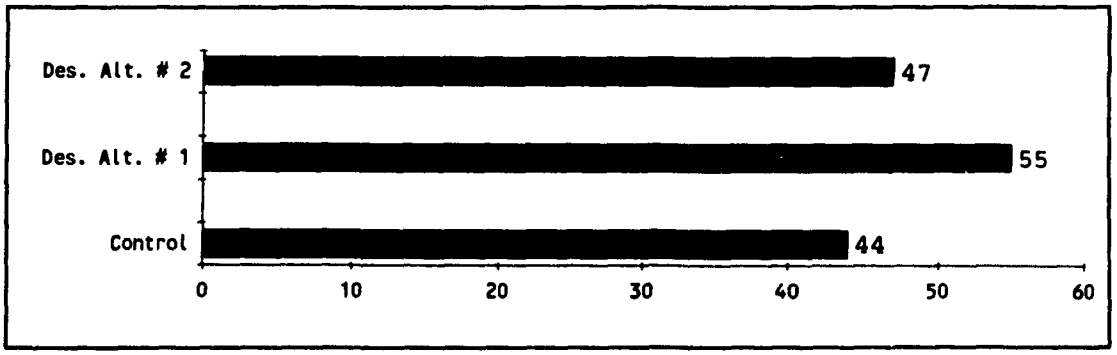

FIGURE NO.53 - COMPARISON OF TOTAL NUMBER OF POLES AND STREETS LAMPS

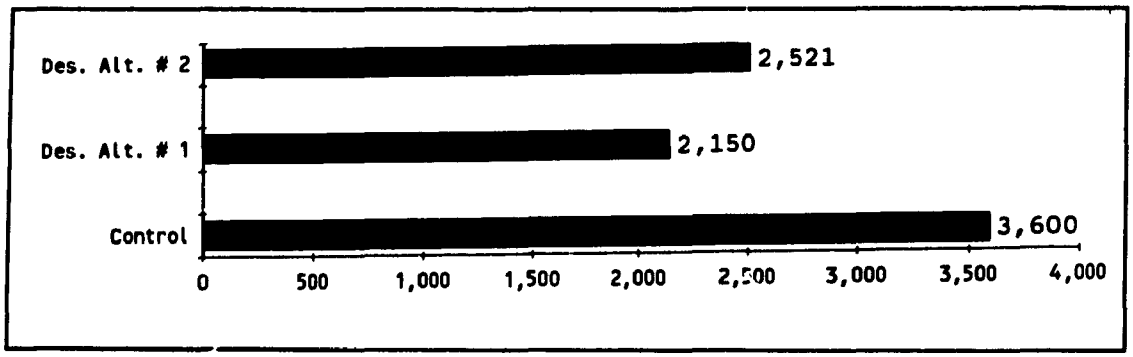

FIGURE NO.54 - COMPARISON OF PAVED AREAS

4. DESIGN ALTERNATIVE # 3

The objective in this third proposal was to identify which guidelines were affecting infrastructure efficiency in order to limit or avoid their use. It was felt that by eliminating the use of lanes and dead-end lanes a more efficient plan could be achieved. It was also thought that by modifying the notion of self-contained and interconnected clusters into a system of grouping plots which were connected through a network of small streets, as shown in figure No.55, a significant decrease in the amount of infrastructure would be reached. The penalty to be paid in this case was that by sacrifying the use of some of the design guidelines, the environmental quality of the plan would be affected.

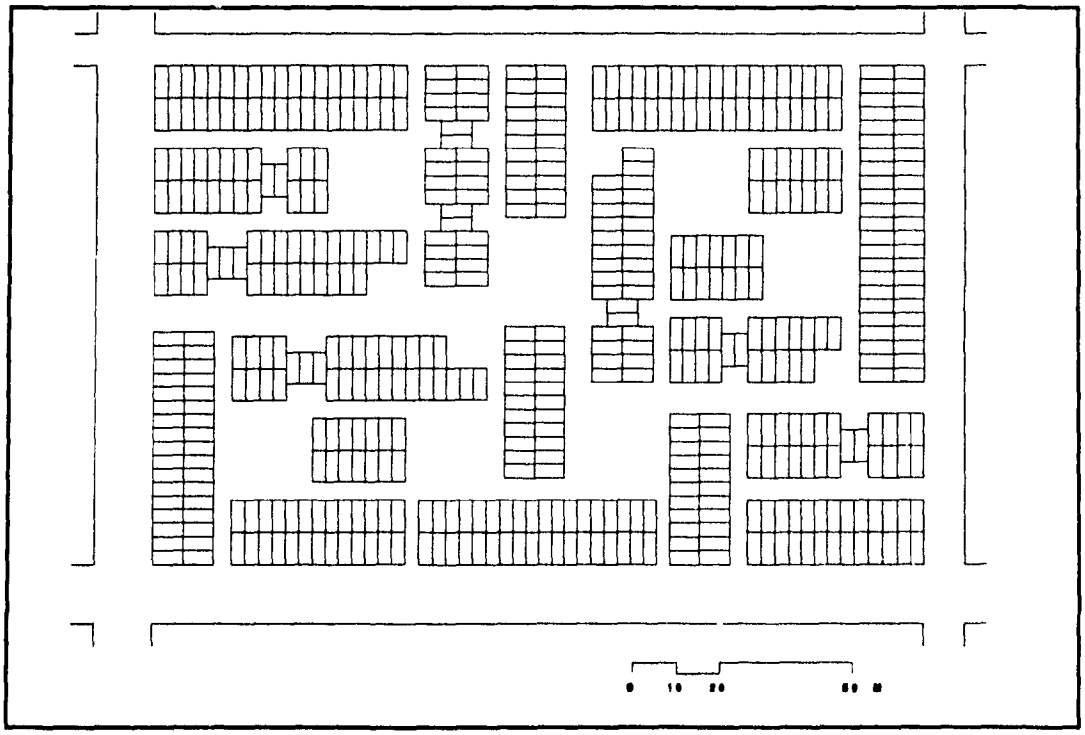

FIGURE NO.55 - PLOT LAYOUT - ALTERNATIVE 3

Dead-end lanes were not used in this third design alternative, given that their use in design options # 1 and 2 proved to have a considerable effect upon the increase in quantities of sewerage, both in the total length of sewers and number of manholes. Given that each dead end lane has to be served by a minimum of two manholes (one at the intersection with the main sewer line and another at the end of the lane), it was felt that by eliminating their use, significant savings in the total number of manholes could be made.

4.1 Land-Use

Land-use areas showed the following results:

a. The total circulation areas were 4,219 M2. These areas, shown in figure No.56, accounted for 22.24% of the total site area.

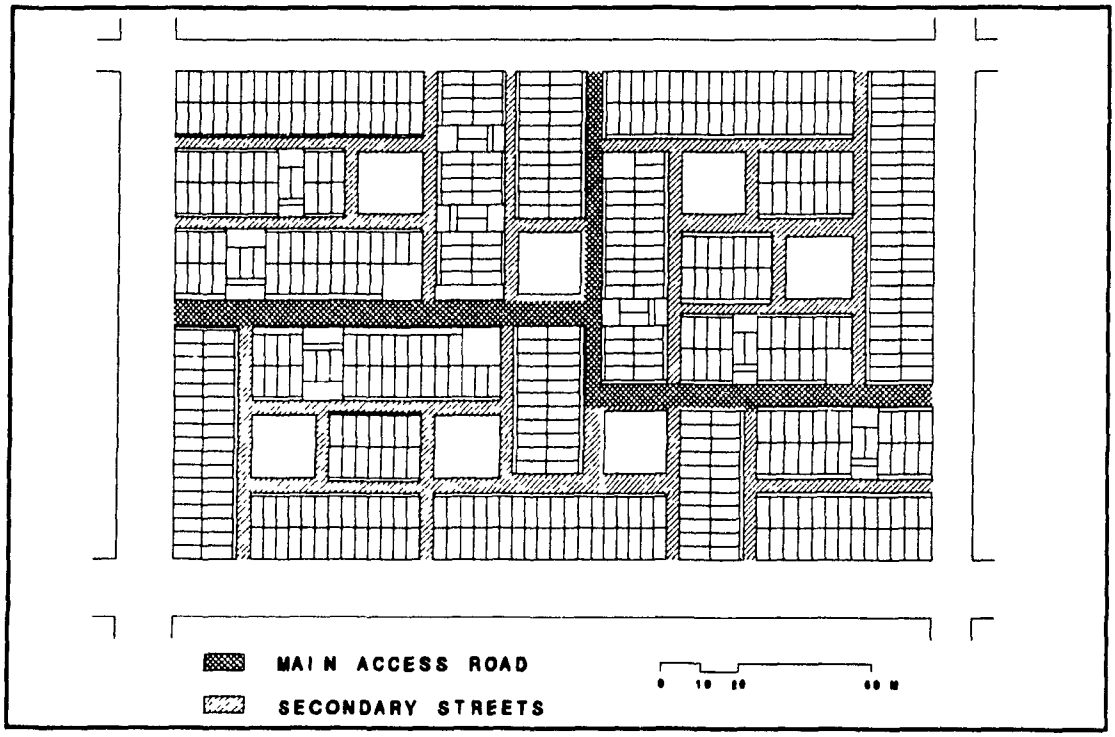

FIGURE NO.56 - CIRCULATION - ALTERNATIVE # 3

b. The total area left for public open spaces, illustrated in figure No.57, accounted for 12.03% of the total site.

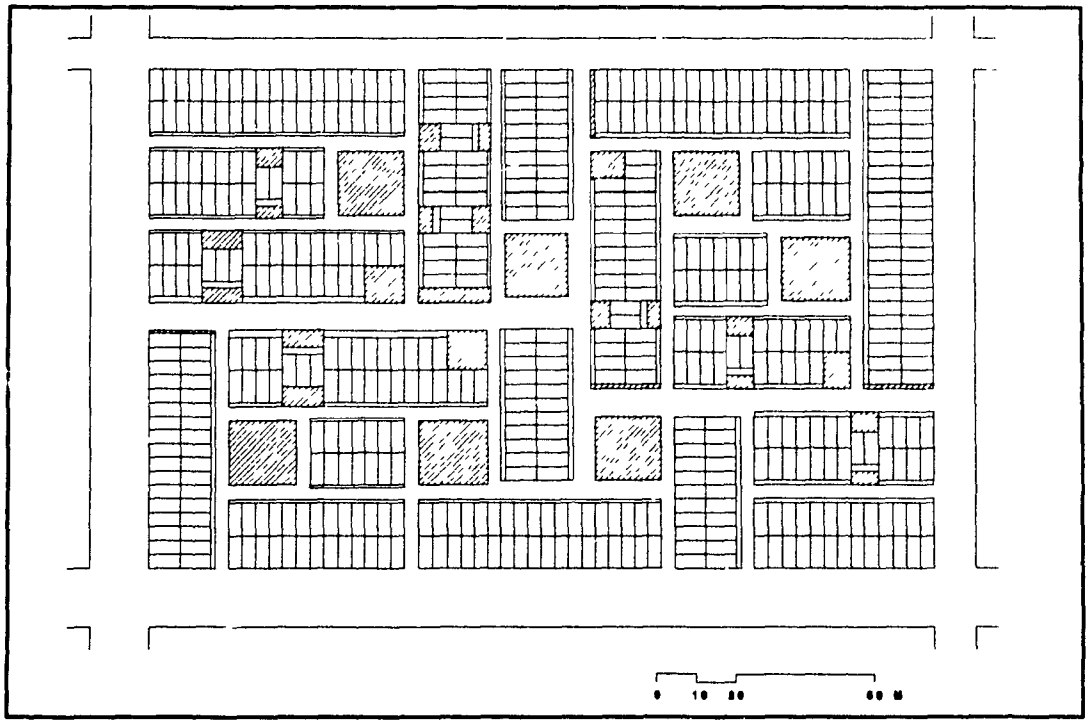

FIGURE NO.57 - PUBLIC OPEN SPACES - ALTERNATIVE # 3

c. The total area left for house extensions, shown in figure No.58, were 1,040 M2. This area accounted for 5.48% of the total site.

d. The total private areas, shown in figure No.59, remained constant at 11,424 M2.

Summary

	M2	% of total site area
Circulation areas	4,219	22.24%
Public open spaces	2,283	12.03%
House extensions	1,040	5.48%
Private area (k)	11,424	60.23%

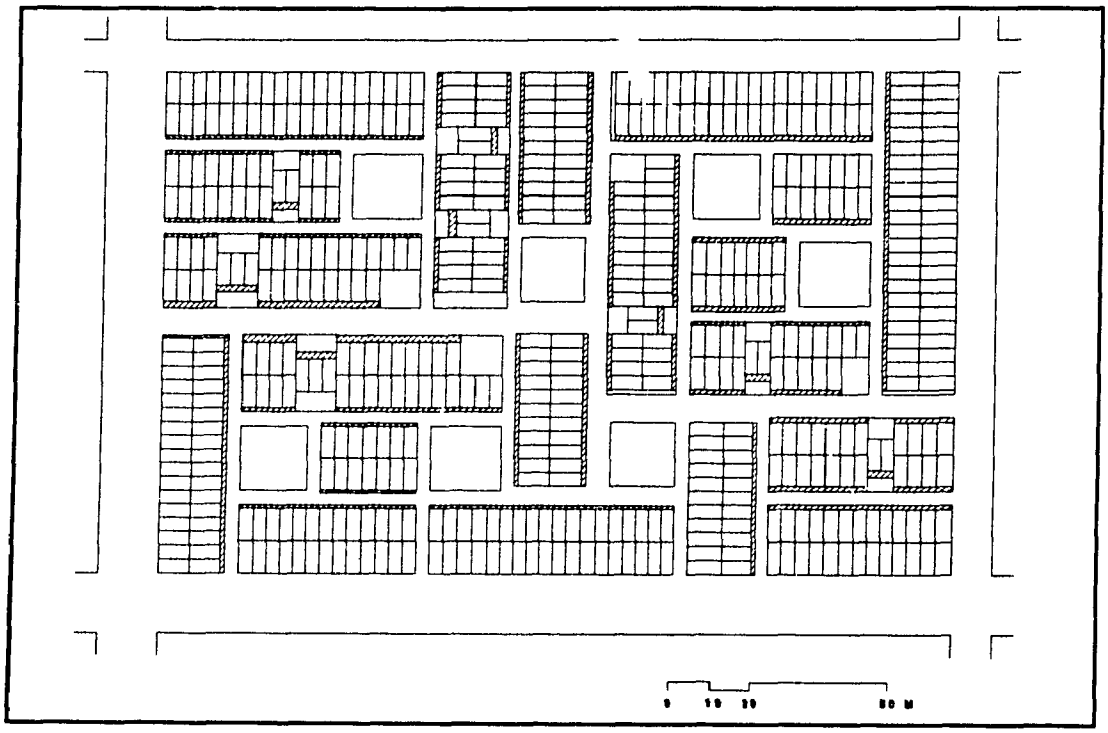

FIGURE NO.58 - HOUSE EXTENSIONS

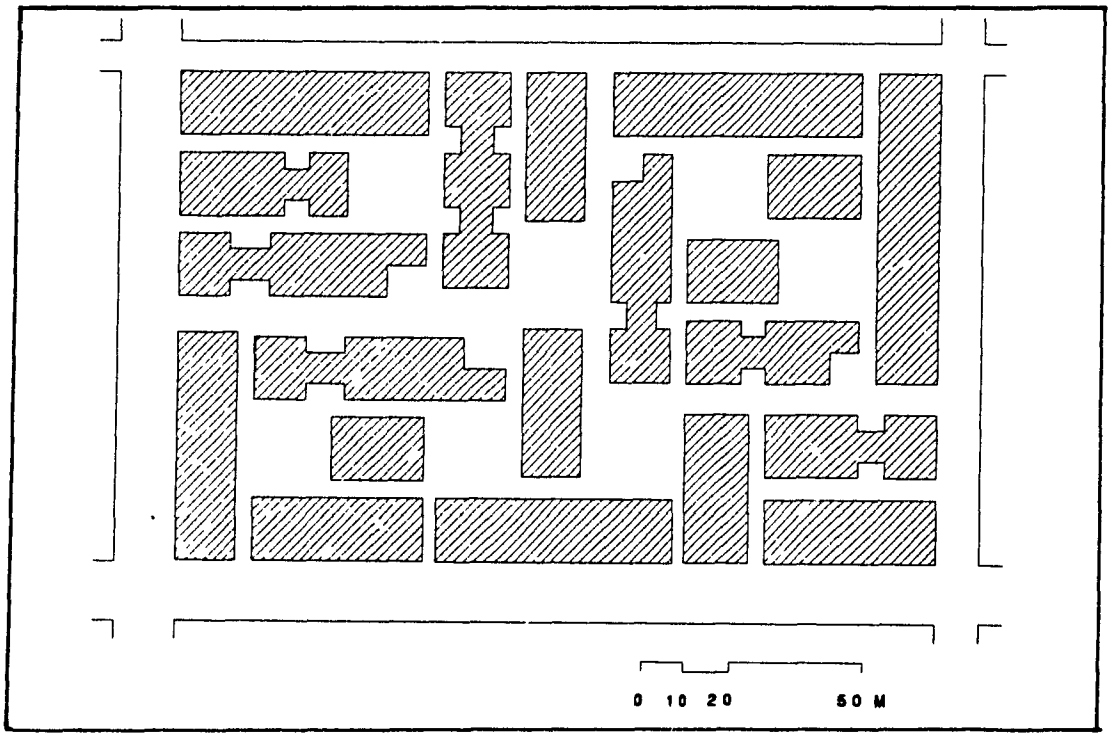

FIGURE NO.59 - PRIVATE AREAS

Analysis

Design alternative # 3 paid penalties in the total areas for circulation and house extensions. However, it evidenced the largest area for public open spaces. The results for each of the three land-use variables under consideration demonstrated that:

1. The total circulation area in this third neighbourhood design was reduced by 9.38% against the control plan, as illustrated in figure No. 60. In reference to design alternatives # 1 and 2, the areas for circulation increased by 16.59%. and 1.3% respectively.
2. The total public open areas in design alternative # 3 were lower than the areas achieved by the control plan. In this case, the total reduction was of 20.89%, as illustrated in figure No.61. This plan, however, proved to be as efficient as design alternative # 1. The net increases against alternatives # 1 and 2 were of 0.78% and 7.47% respectively.
3. The percentage left for house extensions was the smallest of the three design alternatives under consideration, as illustrated in figure No.52. Compared against design alternative # 2, areas for house extensions decreased by 30.38%. The reduction against design alternative # 1 was of 40.84%.

4.2 Infrastructure Efficiency

The principal design consideration made in this third case was that by modifying the clusters into groups of plots connected through a network of small streets, and by eliminating the use of dead-end lanes, a more efficient infrastructure network could be achieved. It was felt

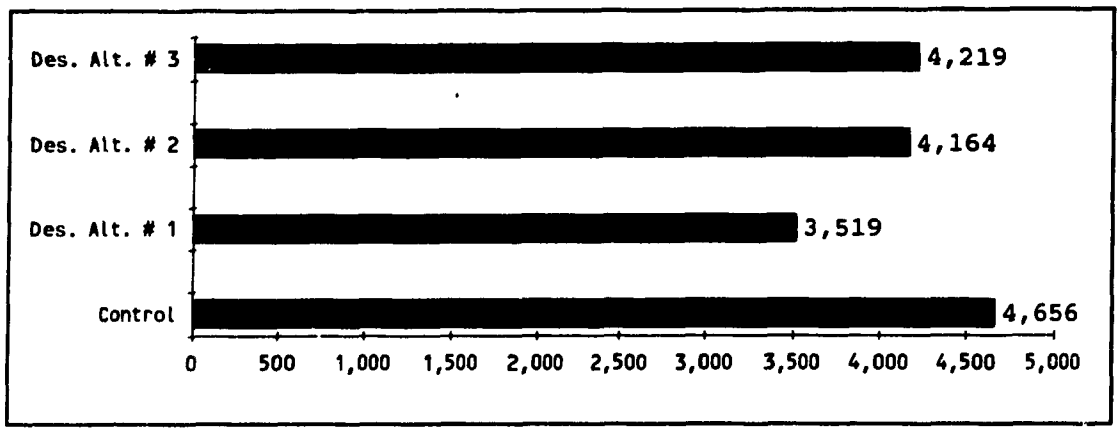

FIGURE NO.60 - COMPARISON OF CIRCULATION AREAS

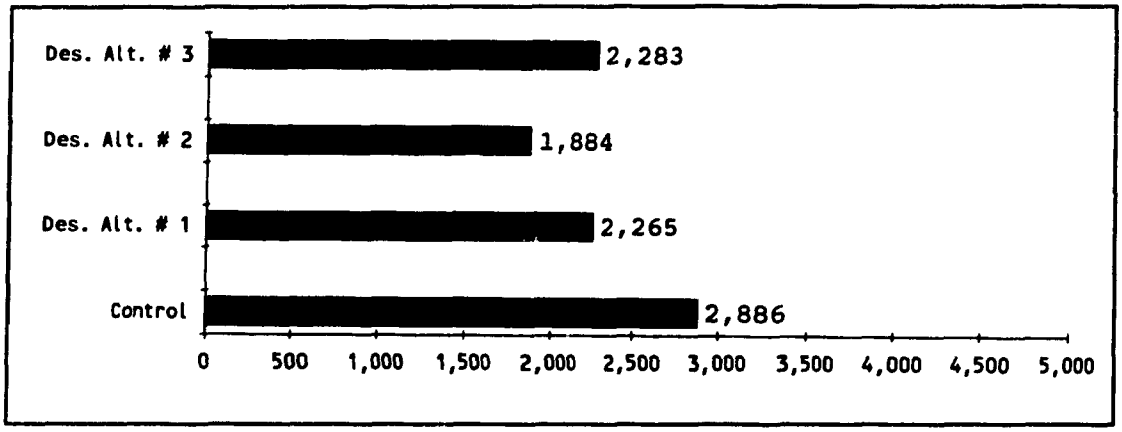

FIGURE NO.61 - COMPARISON OF PUBLIC OPEN SPACES

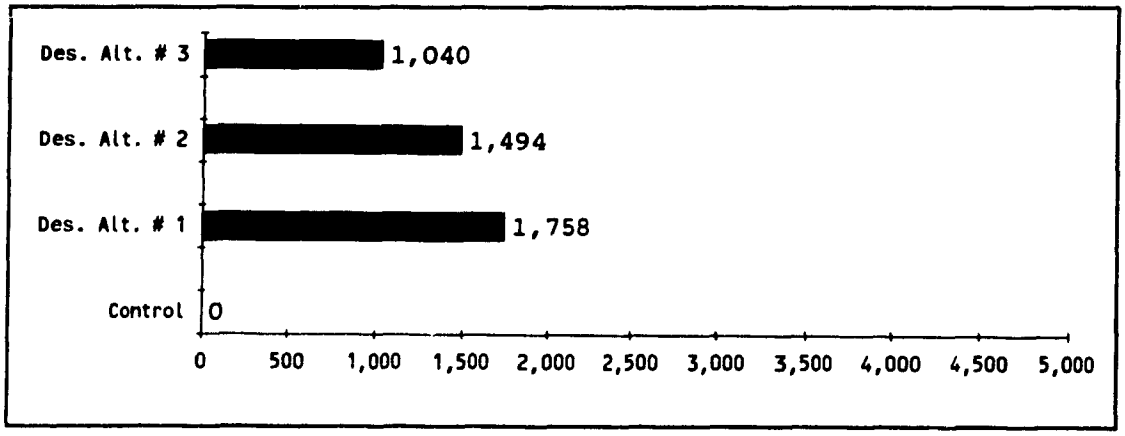

FIGURE NO.62 - COMPARISON OF AREAS FOR HOUSE EXTENSIONS

that by using a more regularized design, quantities of infrastructure could be decreased. In the section that follows, the main considerations made for the design of each infrastructure network and the results achieved, are presented.

4.2.1 Water Supply

Design considerations for the water supply network, shown in figure No.63, were:

1. Connections to the main peripheral water supply lines were made at each intersection between a neighbourhood street and a peripheral street.
2. The primary water supply lines within the neighbourhood were located along the access road.
3. All water supply lines were laid out along the streets.

The total length of the water supply lines was of 1,466 mts.

4.2.2 Sewage Disposal

Design considerations for the sewage disposal system, shown in figure No.64, were:

1. The sewage network was divided into several sectors, each one servicing a single street with direct access to the main sewer lines laid out along the peripheral streets.
2. All sewerage lines were laid out along the streets.
3. An average of six plots on either side of the street were connected to a single manhole. As a result, spacing between manholes was set at an average of 18 meters.

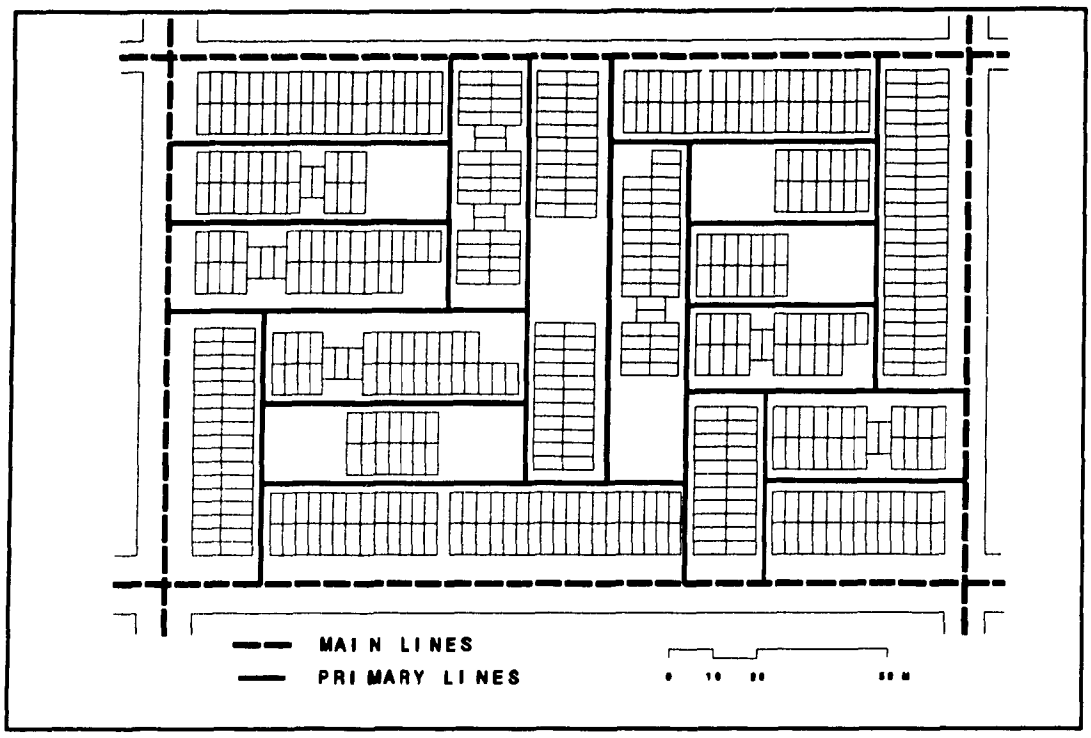

FIGURE NO.63 - WATER SUPPLY

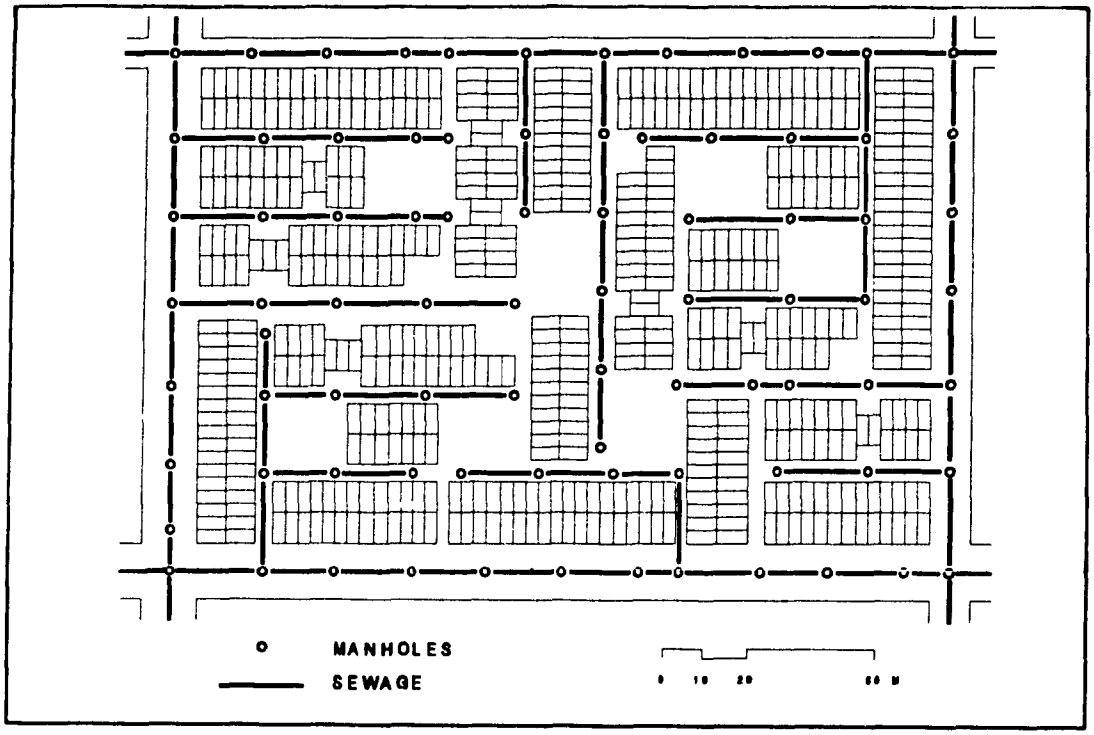

FIGURE NO.64 - SEWAGE DISPOSAL

The total length of sewers was of 1,158 mts. The total number of manholes was of 64.

4.2.3 Electricity

Design considerations for the electricity network, shown in figure No.65, were:

1. The electricity network was divided into four circuits, each one covering approximately 25% of the plots.

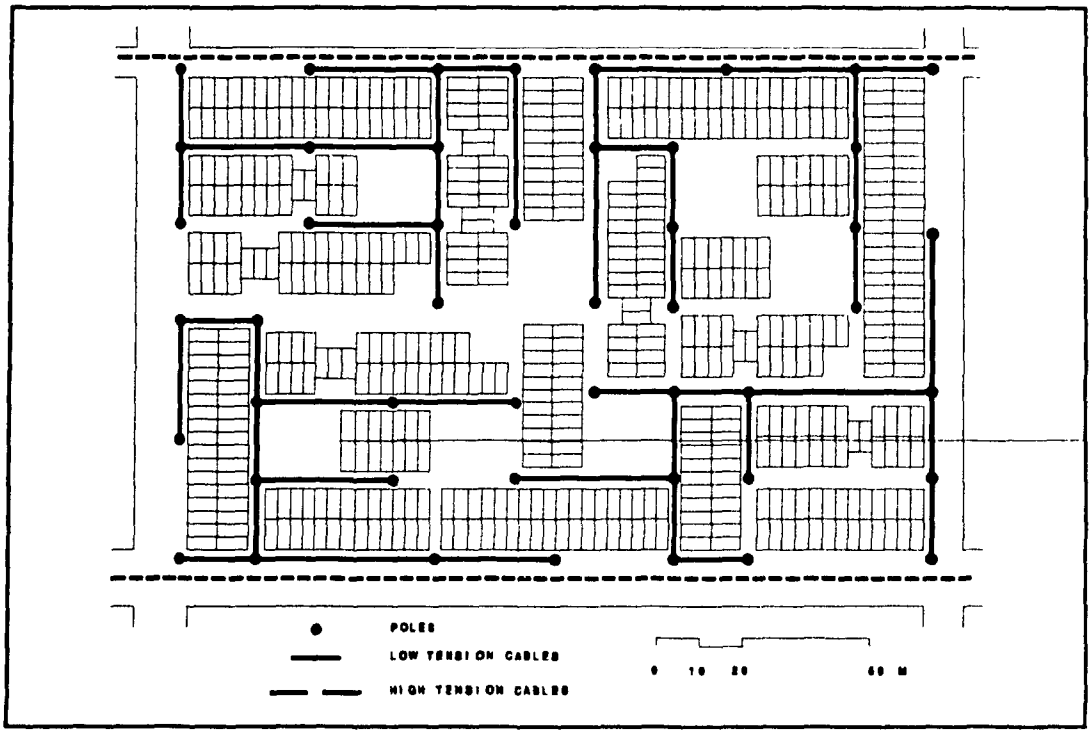

FIGURE NO.65 - ELECTRICITY NETWORK

2. Individual drops were shorter than 30 meters.
3. Public lamps were preferably located at street intersections and i n small squares.

The total length of the electrical lines was of 1,063 mts. The number

of poles and street lamps required was of 48.

4.2.4 Paving

Design considerations for street paving areas, illustrated in figure No.66, were:

1. All the portions of the access roads assigned for circulation were to be paved.
2. The portions intended for circulation of all small streets intersecting the access road, were to be paved from the intersection with the access road to the intersection with a small square.
3. The portions assigned for circulation of all small streets intersecting peripheral streets, were to be paved from the intersection with the peripheral street to the intersection with the square.
4. The portions assigned for circulation of all small streets linking the access road to peripheral streets and not connecting squares, were to be paved from the intersection with the access road to the intersection with the peripheral street.

The total area to be paved was of 2,696 M2.

Summary

Water supply	1,466 mts
Sewage disposal	1,158 mts
Number of manholes	64 u.
Electricity	1,063 mts
Poles/street lamps	48 u.
Paving	2,696 M2

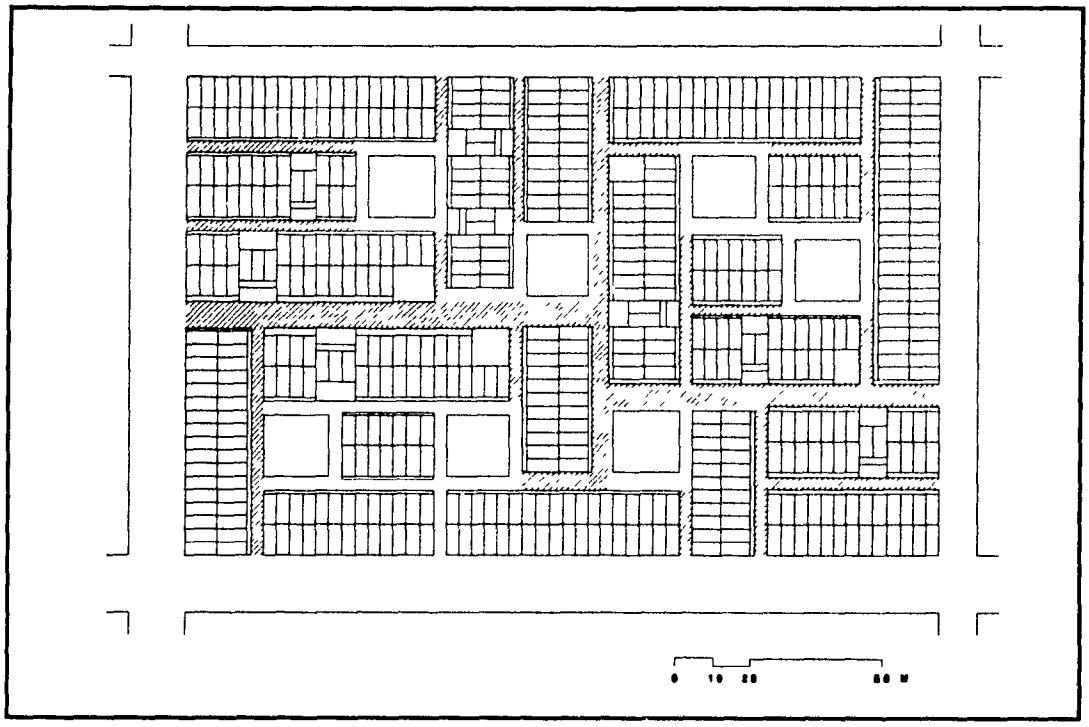

FIGURE NO.66 - STREET PAVING

Analysis

1. The total length of the water supply networks was similar to the quantities achieved by all other neighbourhood plans including the control plan, as illustrated in figure No.67.
2. Design alternative # 3 showed to be less efficient than the control plan with regard to length of sewers, as illustrated in figure No.68. In this case, there was an increase of 15.11%. Design alternative # 3 showed a small decrease in the total length of sewers when compared to design alternatives # 1 and 2. Savings of 6.14% and 4,13% were respectively made.
3. Although the total number of manholes in design alternative # 3 dropped significantly with regard to design alternatives # 1 and 2,

the quantity achieved was still much greater than the one achieved by the control plan. When compared to this last plan, design alternative # 3 evidence an increase of 17.18%, as illustrated in figure No.69. However, compared against design alternatives # 1 and 2, the reduction attained was of 17.94% and 14.66% respectively.

4. Quantities for electricity in design alternative # 3 were higher when compared to the results attained in the control plan, as showed in figure No.70. In this case, design alternative # 3 presented an increase of 12.22%. This third design alternative, was also more efficient than the first two design options. In these last two cases, net reductions of 9.91% and 1.75% were respectively achieved.
5. The number of poles and street lamps in design alternative # 3 was reduced by 12.72% in reference to design alternative # 1. On the other hand, design in reference to design alternative # 2 and to the control plan, design alternative # 3 was less efficient, as illustrated in figure No.71. When compared to the control plan and design alternative # 2, the increases were of 8.33% and 2.08% respectively.
6. Given the increase in circulation areas, penalties were paid in terms of street paving. In this case, design alternative # 3 presented an increase of 20.25% over design alternative # 1 and of 6.49% over design alternative # 2. However, in spite of the above increments design alternative # 3 was significantly more efficient than the control plan, as seen in figure No.72. In this case a reduction of 25.11% was achieved.

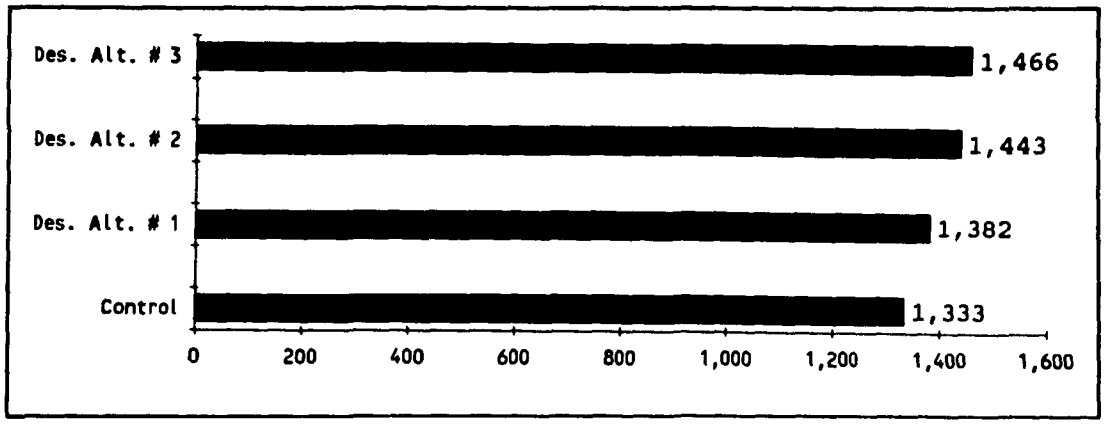

FIGURE NO.67 - COMPARISON OF TOTAL LENGTH OF WATER SUPPLY LINES

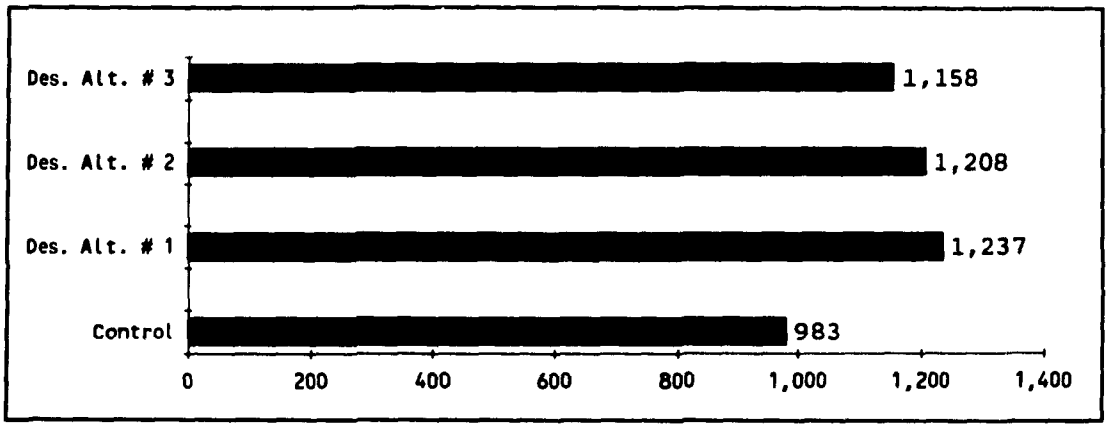

FIGURE NO.68 - COMPARISON OF TOTAL LENGTH OF SEWERAGE NETWORKS

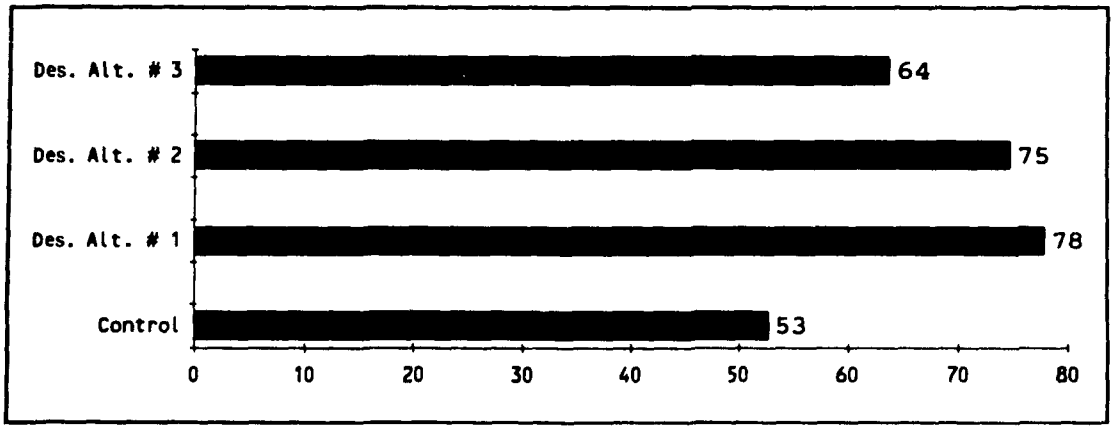

FIGURE NO.69 - COMPARISON OF TOTAL NUMBER OF MANHOLES

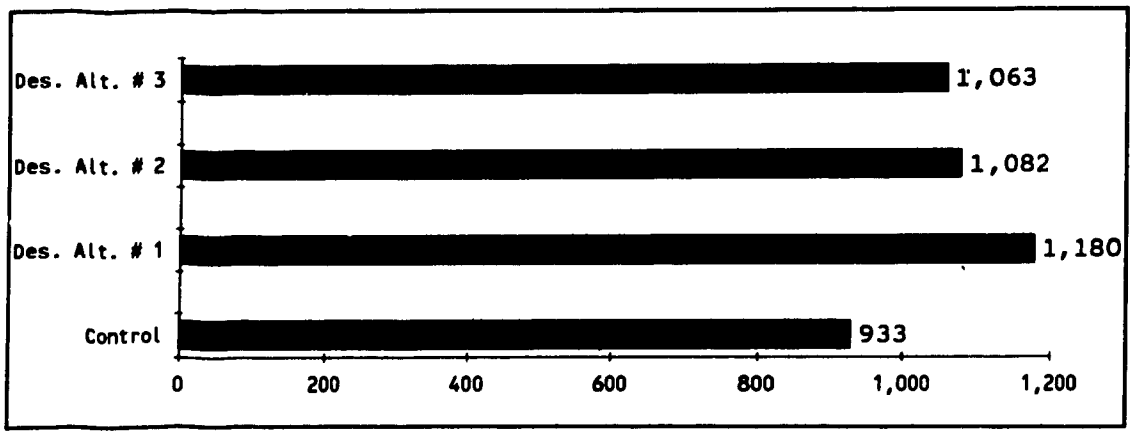

FIGURE NO.70 - COMPARISON OF TOTAL LENGTH OF ELECTRICITY NETWORKS

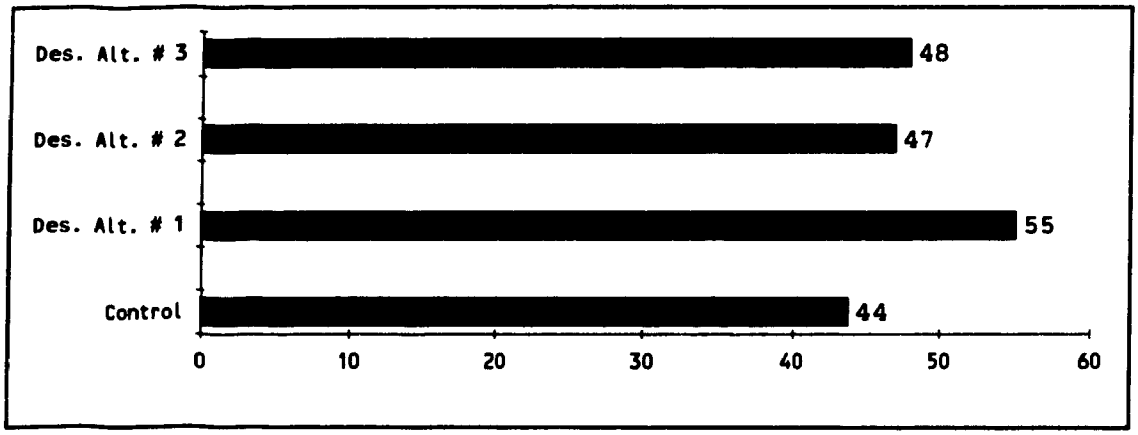

FIGURE NO.71 - COMPARISON OF TOTAL NUMBER OF POLES AND STREET LAMPS

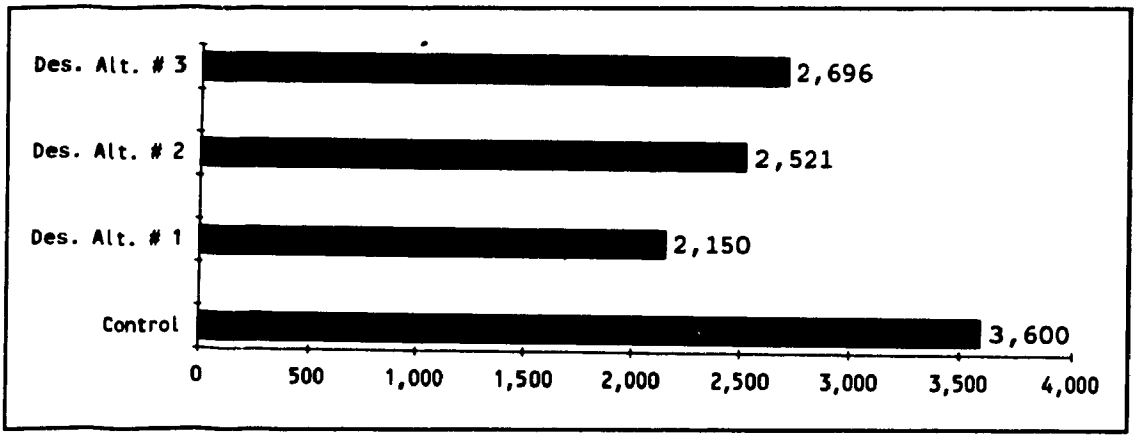

FIGURE NO.72 - COMPARISON OF PAVED AREAS

5. Design Alternative # 4

This design was based on a sites and services project in Aranya Townships, Indore, India, the original plan of which was developed by the Vastu Shilpa Foundation for the Indore Development Authority. This plan was selected because it presented an innovative design alternative, reached through a controlled series of physical modifications to a traditional grid iron layout.

The basic objective in this case was to continue the testing of the assumptions made for the design alternative # 3, relative to the understanding of which guidelines would achieved the level of infrastructure efficiency reached in the control plan. The new design, shown in figure No. 73, included the use of most neighbourhood street guidelines. The only guideline left aside was that relative to the use of dead-end lanes.

As in the previous design alternative, the notion of grouping plots and linking them through a network of small streets was kept. However, the main assumption made in this case was that by eliminating the use of self-contained or interconnected clusters a higher level of infrastructure efficiency could be achieved.

5.1 Land-Use

After completing the new neighbourhood design, the quantitative analysis of land-use areas was done. The data obtained was translated into percentages of the total neighbourhood area. The results obtained for aech of the three land-use variable were:

a. The total circulation areas were of 3,734 M2. These areas, shown in

figure No.74, accounted for 19.68% of the total site area.

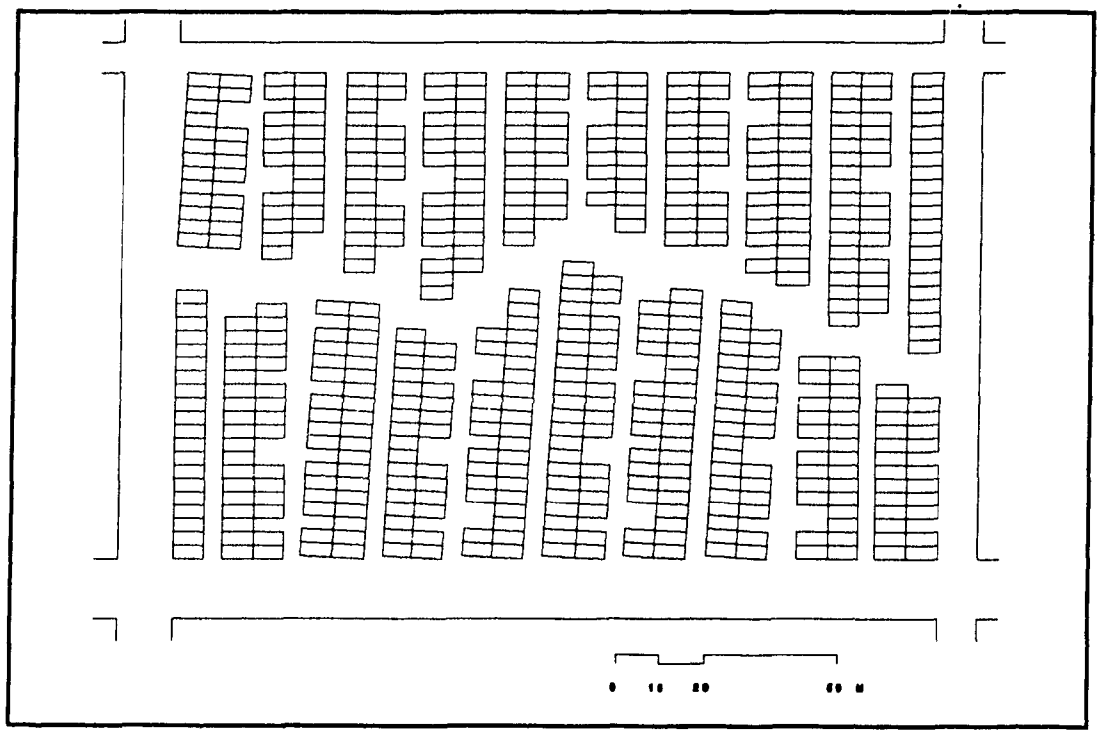

FIGURE NO.73 - PLOT LAYOUT

b. The total area left for open spaces, illustrated in figure No.75, was of 2,190 M2 which accounted for 11.54% of the total site area.

c. The total area left for house extensions, shown in figure No.76, were of 1,618 M2 which accounted for 8.53% of the total site area.

d. The total private areas, shown in figure No.77, remained constant at 11,424 M2.

Summary

	M2	% of total site area
Circulation areas	3,734	19.68%
Public open spaces	2,190	11.55%
House extensions	1,618	8.54%
Private area (k)	11,424	60.23%

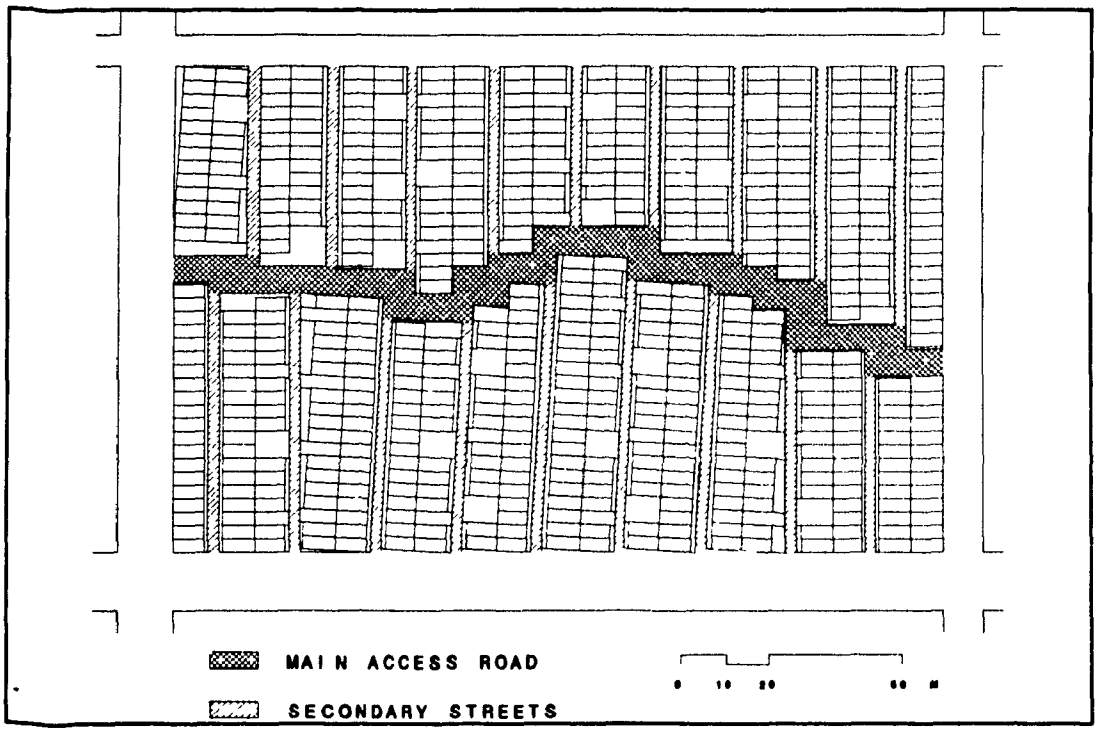

FIGURE NO.74 - CIRCULATION

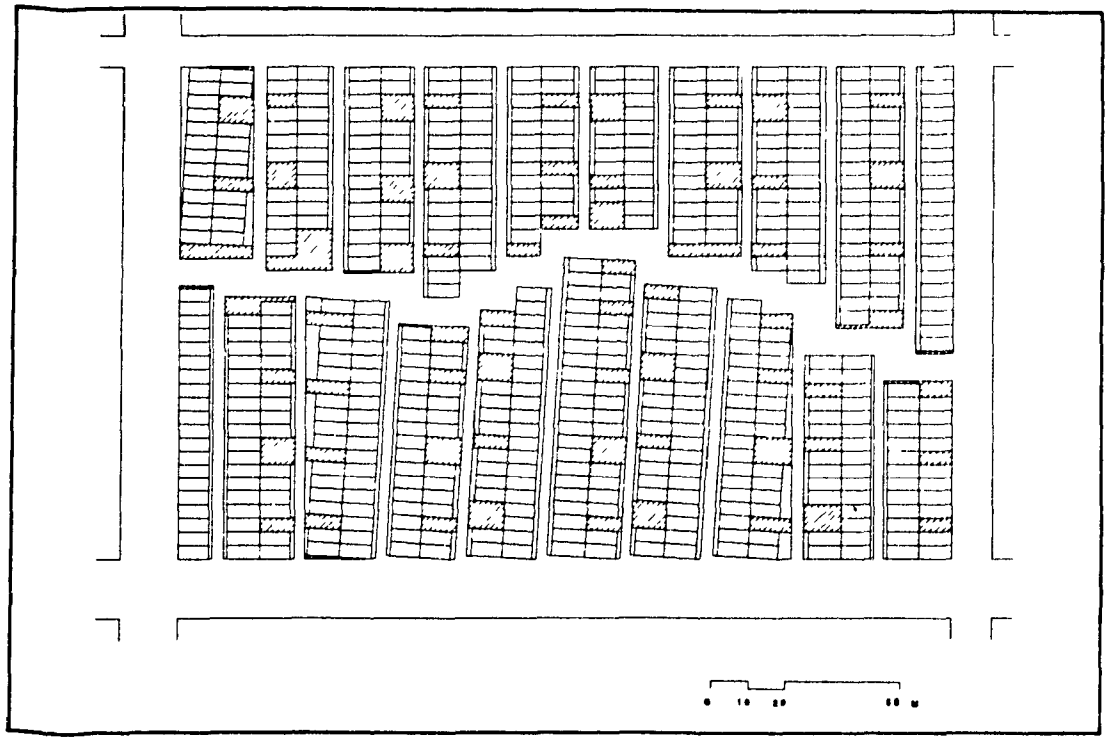

FIGURE NO.75 - PUBLIC OPEN SPACES

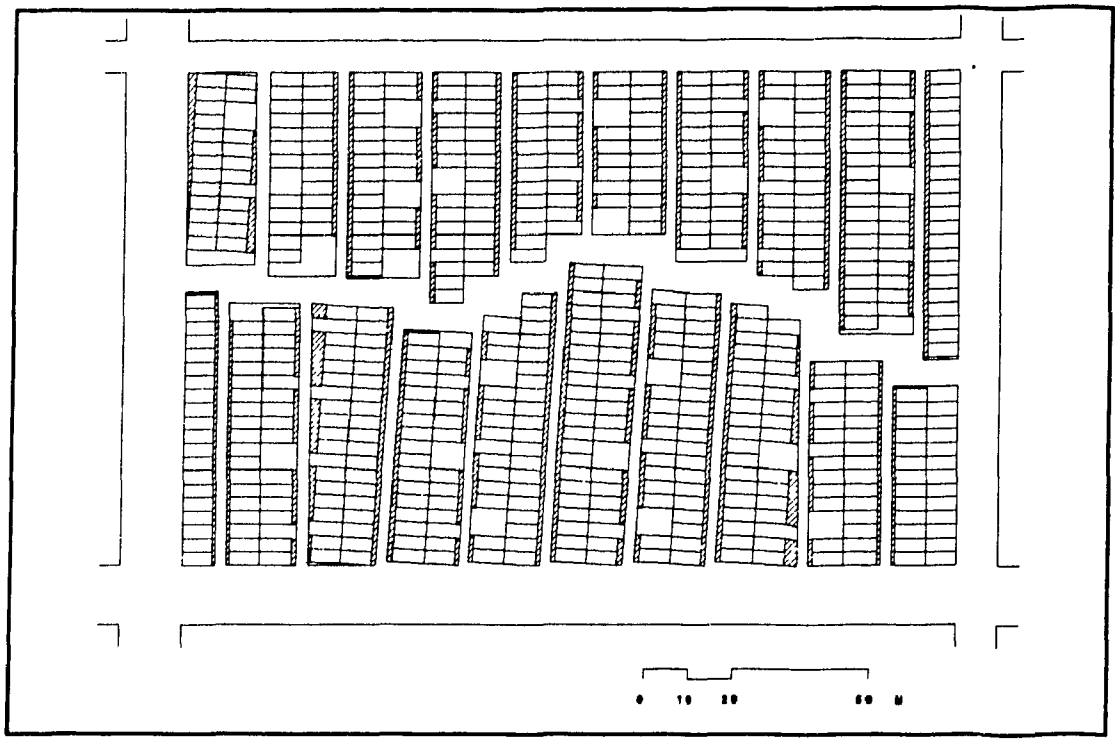

FIGURE NO.76 - HOUSE EXTENSIONS

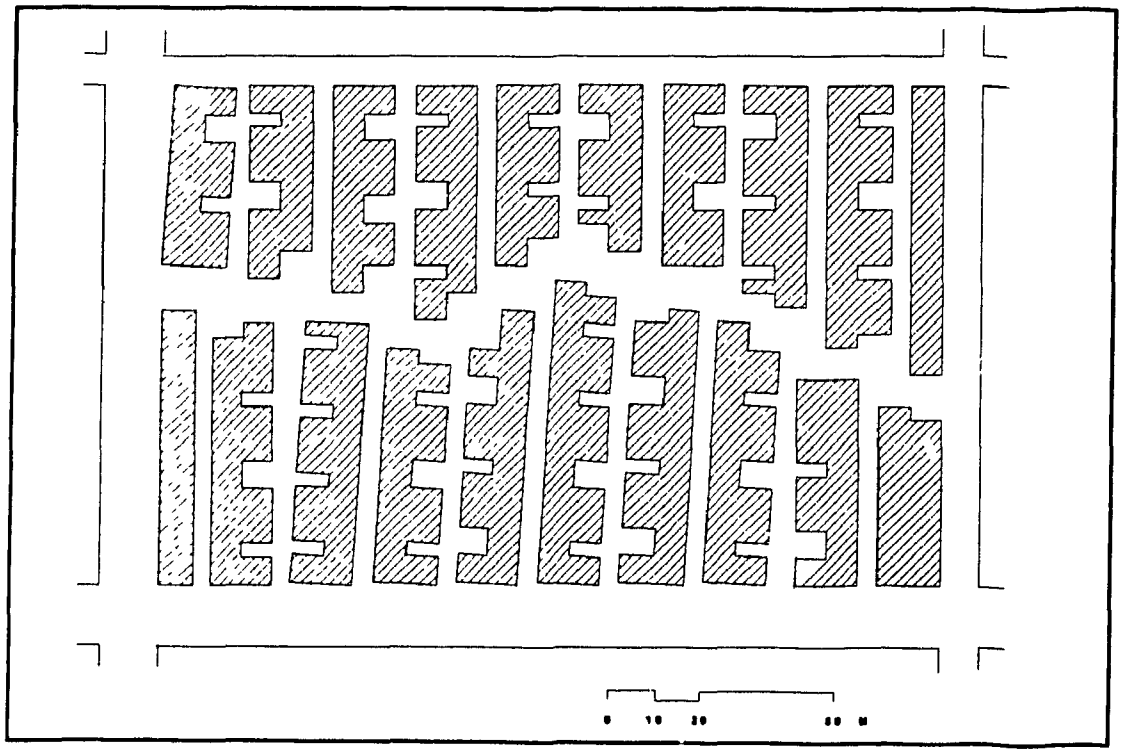

FIGURE NO.77 - PRIVATE AREAS

Analysis

1. The total circulation area in design alternative # 4 decreased in reference to the control plan by 19.8%.design alternatives # 3 and 2, by 11.5% and 10.32% respectively. However, Circulation areas in this fourth design alternative were greater than to those achieved in design alternative # 1. In this case, the increase was of 5.76% as illustrated in figure No.78.
2. The largest difference in areas for public spaces, was obtained in reference to the control plan. In this case, public areas decreased by 24.12% over the control plan. Areas for public open spaces did not show a significant modification with respect to the other three design alternatives. Compared to design alternatives # 3 and 1, the total area for public open spaces dropped by 4.07% and 3.31% respectively. On the other hand, public open areas augmented from 1.884 M2 in design alternative # 2 to 2,190 M2 in design alternative # 4, as shown in figure No.79. This difference represented a net increase of 13.97%.
3. The decrease in areas for circulation and open spaces was reflected in an increase in areas for house extensions. As a result, these areas augmented in reference to design alternatives # 3 and 2 by 35.72% and 7.66%. However, when compared to design alternative # 2, the total areas for house extensions decreased from 1,758 M2 to 1,618 M2 in design alternative # 4, as illustrated in figure No.80. This difference represented a net decrease of 7.96% over alternative # 2.

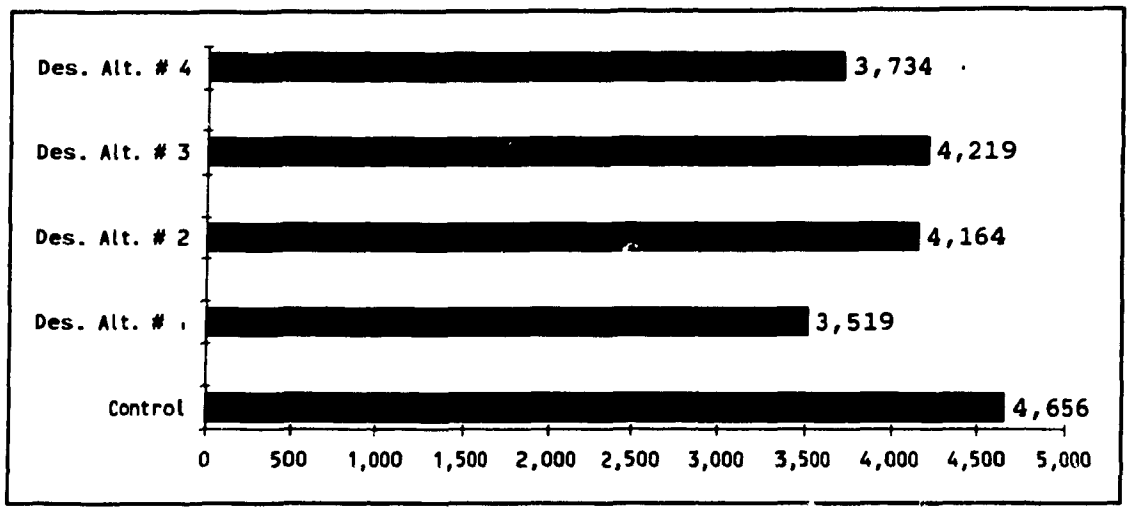

FIGURE NO.78 - COMPARISON OF CIRCULATION AREAS

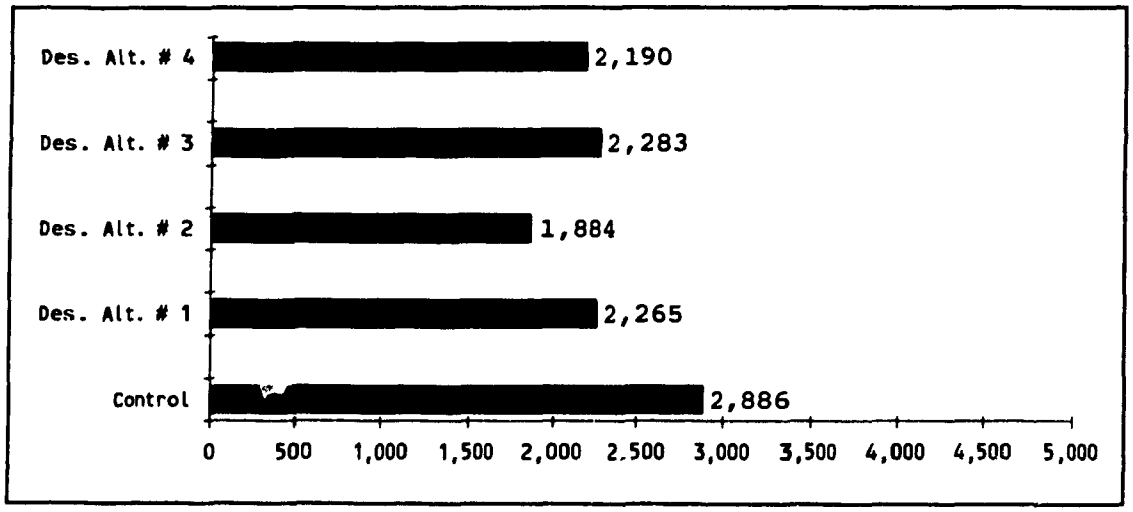

FIGURE NO.79 - COMPARISON OF PUBLIC OPEN SPACES

5.2 Infrastructure Efficiency

The principal assumption made in design alternative # 4 was that by eliminating the use of dead-end lanes, and by avoiding the use of groups of plots interconnected through networks of small streets, a significant decrease in the amount of infrastructure would be made. An important

feature of this new neighbourhood design was the possibility of using

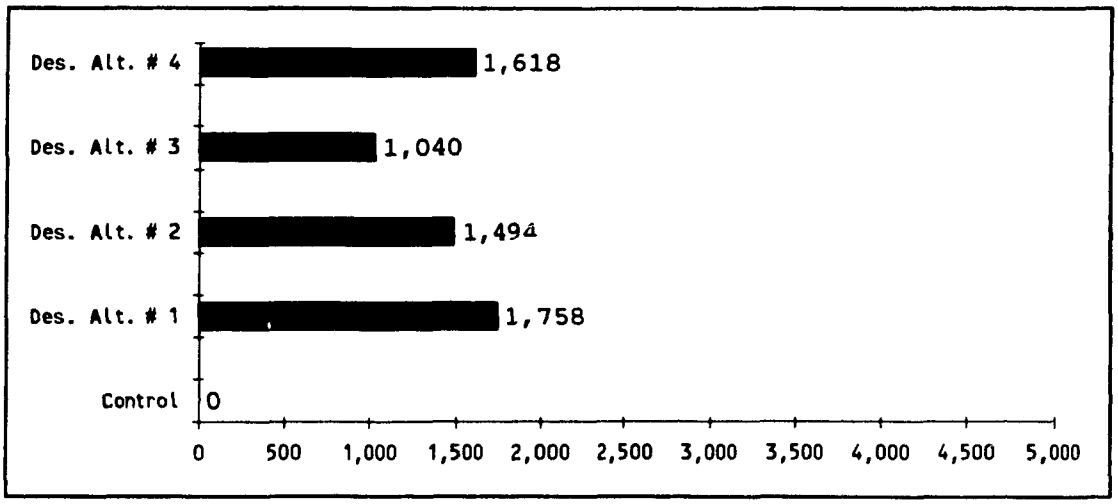

FIGURE NO.80 - COMPARISON OF AREAS FOR HOUSE EXTENSIONS

street widenings as service slots. In fact, the use of these spaces as services areas was a modification which enabled to run water supply and sewer lines on alternate streets. This possibility, in turn, led to significant cost reductions on both: water supply lines and length of sewers.

5.2.1 Water Supply

The main design considerations in laying out the water supply network, shown in figure 81, were:

1. Water supply lines ran on alternate streets having service slots.
2. Connections to the main peripheral water supply lines were provided at every street intersection between a neighbourhood street having service slots and a peripheral street.
3. Water supply lines were laid out along small streets and public open spaces.

The total length of the water supply lines was of 885 meters.

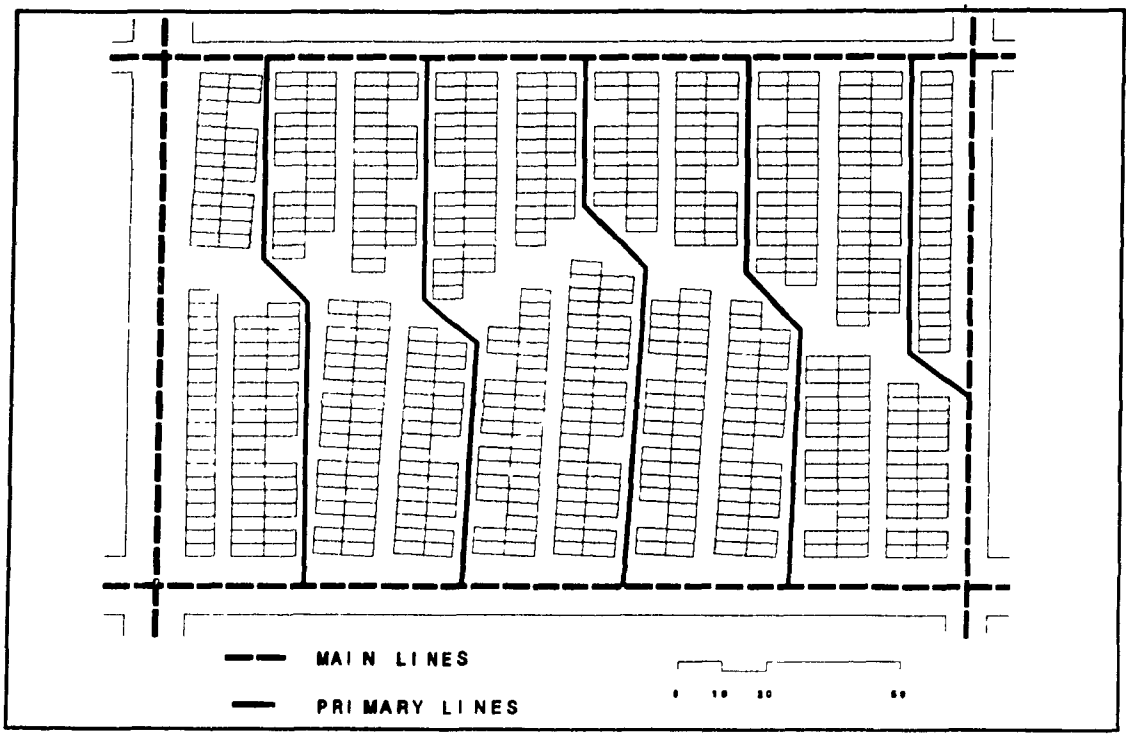

FIGURE NO.81 - WATER SUPPLY

5.2.2 Sewage

The main design considerations in laying out the sewage disposal network, shown in figure 82, were:

1. The sewage network was divided into various sectors, each one servicing a single street with service slots.
2. Due to the use of the service slots, the number of plots connected to a manhole could be increased from an average of 12 plots in previous designs to an average of 20.

The total length of sewers was of 784 meters. The total number of manholes was of 43.

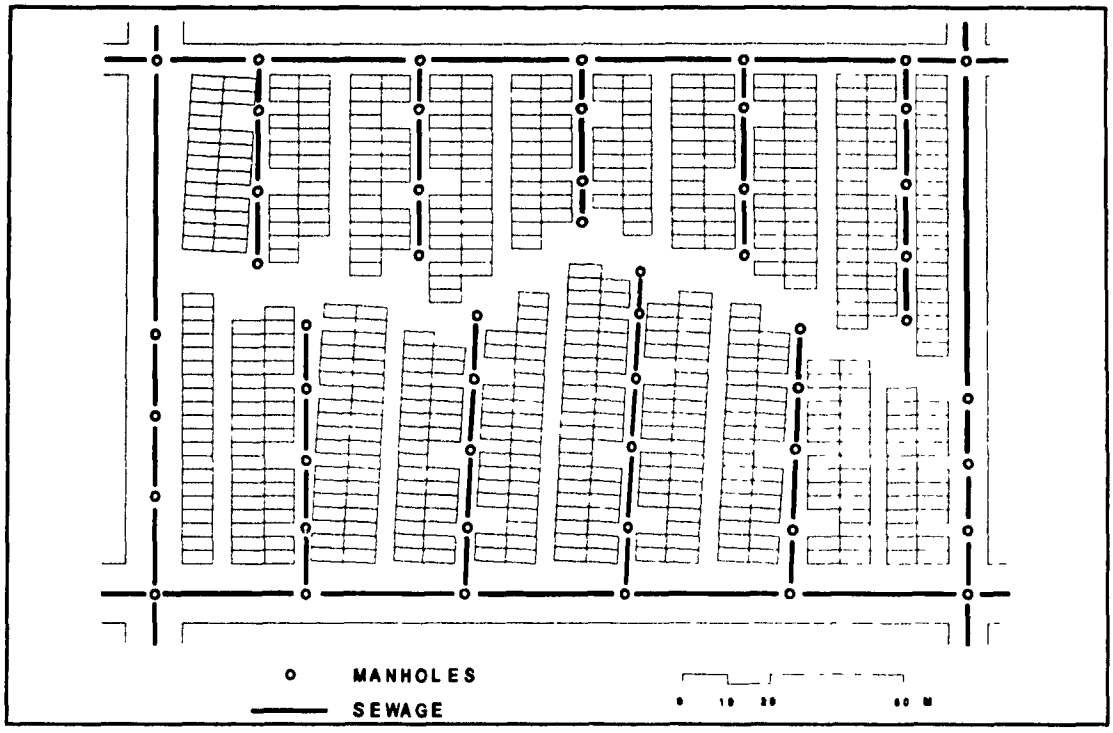

FIGURE NO.82 - SEWAGE NETWORK

5.2.3 Electricity

Design considerations for the electricity network, shown in figure No.83, were:

1. The electricity network was divided into four circuits. Each circuit had one transformer of 150 KVA serving approximately 25% of the plots. The average level of consumption was estimated at 1 KVA per plot.
2. Electrical lines were laid down on small neighbourhood streets.
3. Public lamps were located at street intersections and in every cluster.
4. Individual drops were shorter than 30 meters.

The total length of the electricity network was of 1,305 meters. The

number of poles and street lamps was of 71.

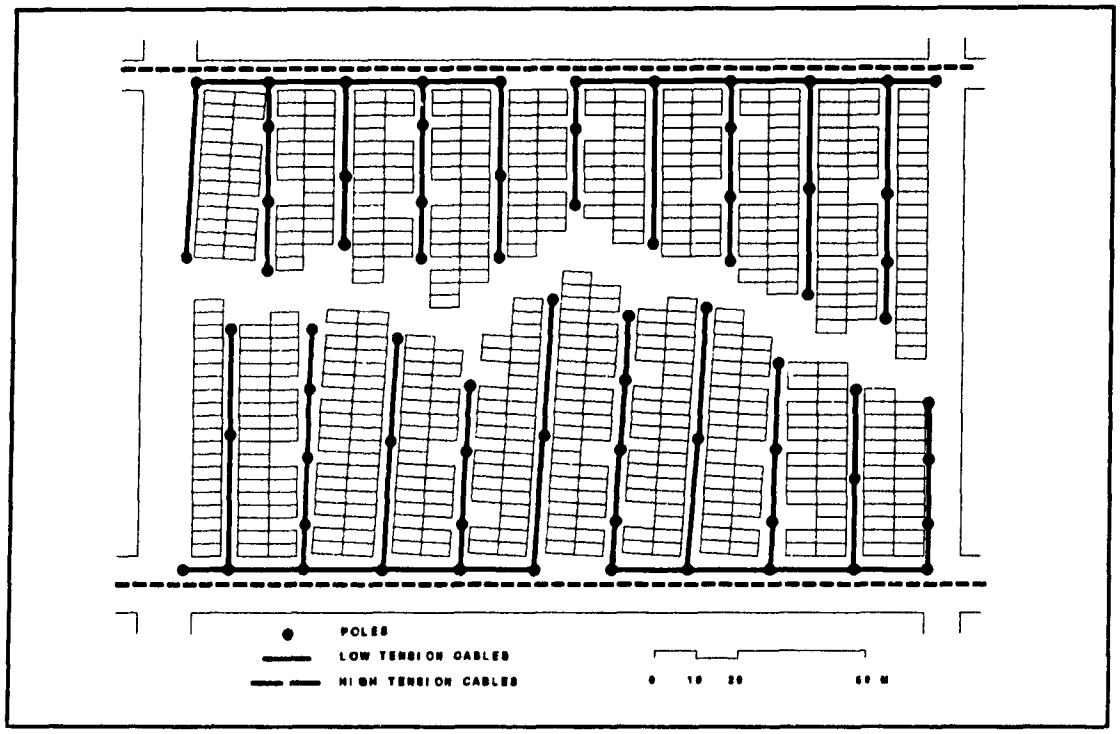

FIGURE NO.83 - ELECTRICITY NETWORK

5.2.4 Paving

1. The only areas to be paved were the portions assigned for circulation in all small streets intersecting the access road, from the intersection with the access road to the intersection with a small square, as illustrated in figure No.84.

The total areas to be paved were of 2,170 M2.

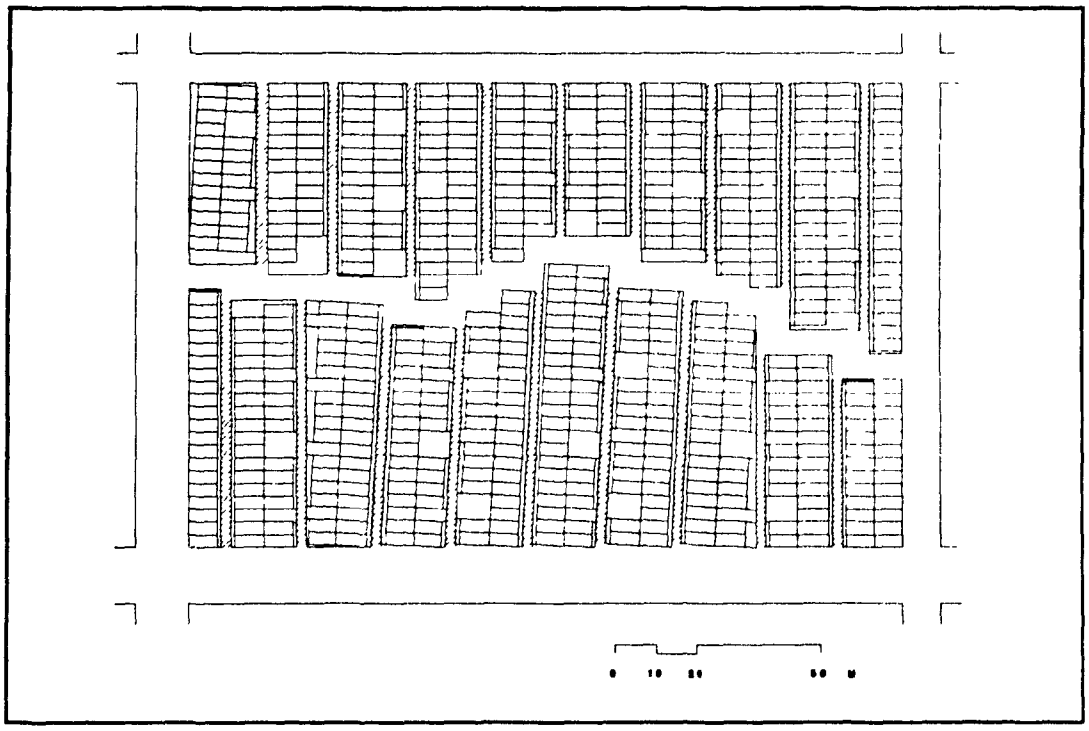

FIGURE NO.84 - STREET PAVING

Summary

The following material presents the performance for infrastructure efficiency in design alternative # 4:

Water supply	885 M
Sewage disposal	784 M
Number of manholes	43 u.
Electricity	1,305 M
Poles/street lamps	71 u.
Paving	2,170 M2

Analysis

The evaluation of the results obtained in this last option showed that:

1. The total length of sewers in this last neighbourhood plan evidenced

a major decrease over all the design options under consideration including the control plan, as illustrated in figure No.85. When compared to design alternatives # 3,2 and 1, the reductions were of 32.29%, 35.1%, and 36.62% respectively. The net reduction achieved in design alternative # 4 over the control plan was of 20.24%.

2. The number of manholes required in design alternative # 4 was the smallest of all the design options under consideration, as shown in figure No.86. In this case, the number of manholes dropped by 32.81%, 42.66%, and 44.87% with respect to options # 3, 2 and 1. Compared against the control plan the reduction was of 18.86%.
3. The total length of electrical lines was the highest of all the design alternatives, as illustrated in figure No.87, being this the major penalty paid. the net increments over design alternatives # 3,2 and 1, were of 18.54%, 17.08%, and 9.57% respectively. The highest increment, 28.5%, was evidenced against the control plan.
4. The number of poles and street lamps was also much greater than the number required in any of four previous neighbourhood plans, as illustrated in figure No.88. The net increase in reference to design alternatives # 3,2 and 1 was of 32.39%, 33.8% and 22.53% respectively. The highest increment, 38.02 per cent, was evidenced against the control plan.
5. Of all the design options under consideration, including the control plan, this last design proved to be the most efficient with regard to water supply, as illustrated in figure No.89. The net savings over design alternatives # 3,2 and 1 were of 39.63%, 38.66%, and 35.96% respectively. The net reduction against the control plan was 33.6%.

6. Street paving showed a significant decrease in reference to design alternatives # 3 and 2, as well as to the control plan. Reductions of 19.52%, 13.92% and 39.72% were respectively achieved. On the other hand, the results obtained for street paving in design alternative # 4, seen in figure No.90, matched the results achieved in the design alternative # 1, which was the most efficient of all the designs.

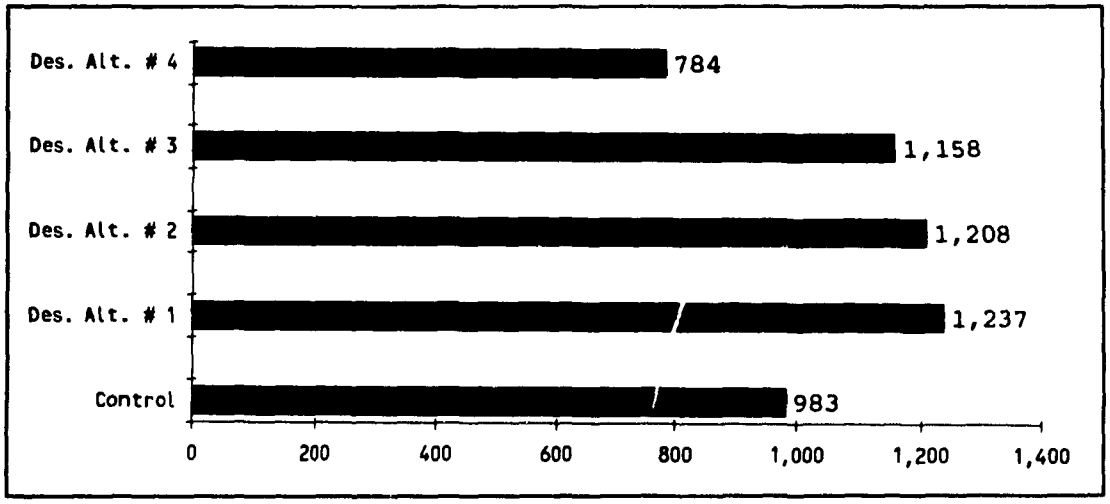

FIGURE No.85 - COMPARISON OF TOTAL LENGTH OF SEWERAGE NETWORKS

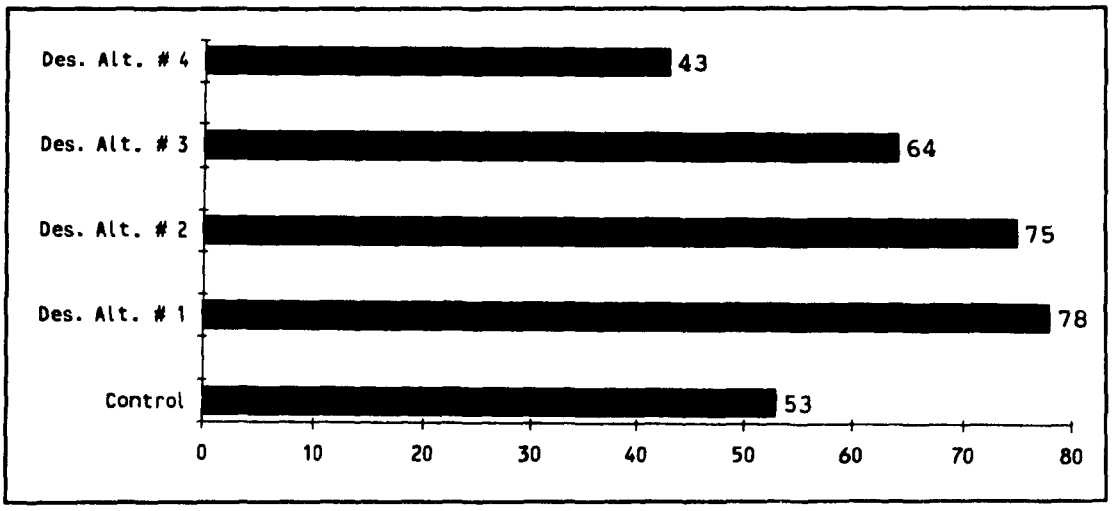

FIGURE No.86 - COMPARISON OF TOTAL NUMBER OF MANHOLES

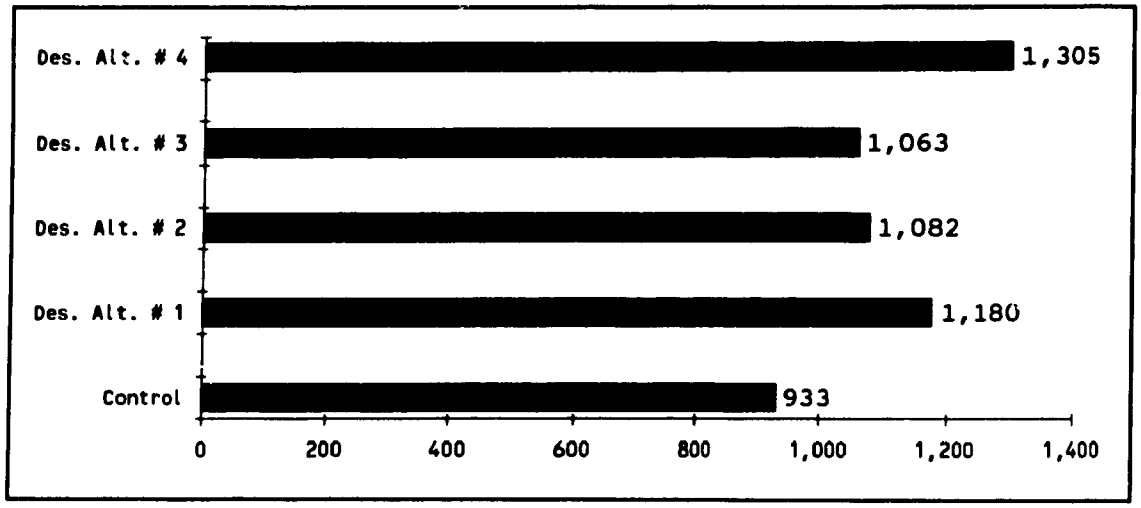

FIGURE NO.87 - COMPARISON OF TOTAL LENGTH OF ELECTRICITY NETWORKS

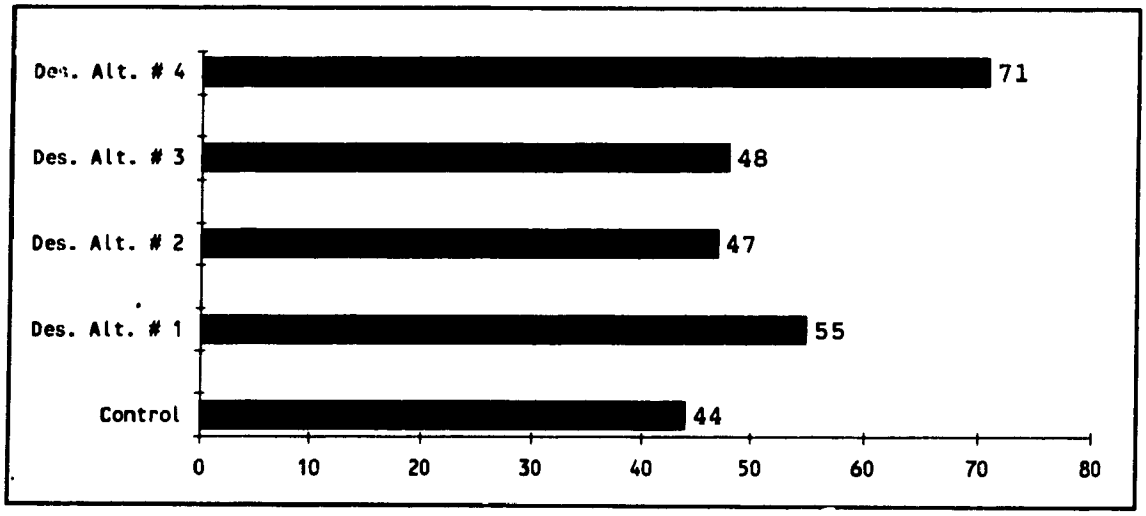

FIGURE NO.88 - COMPARISON OF TOTAL NUMBER OF POLES AND STREET LAMPS

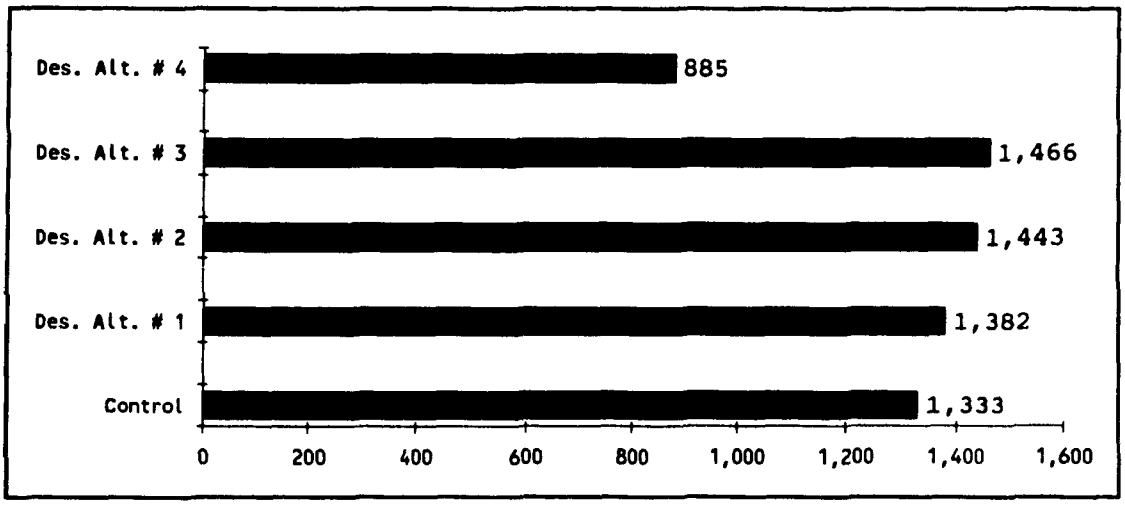

FIGURE NO.89 - COMPARISON OF TOTAL LENGTH OF WATER SUPPLY

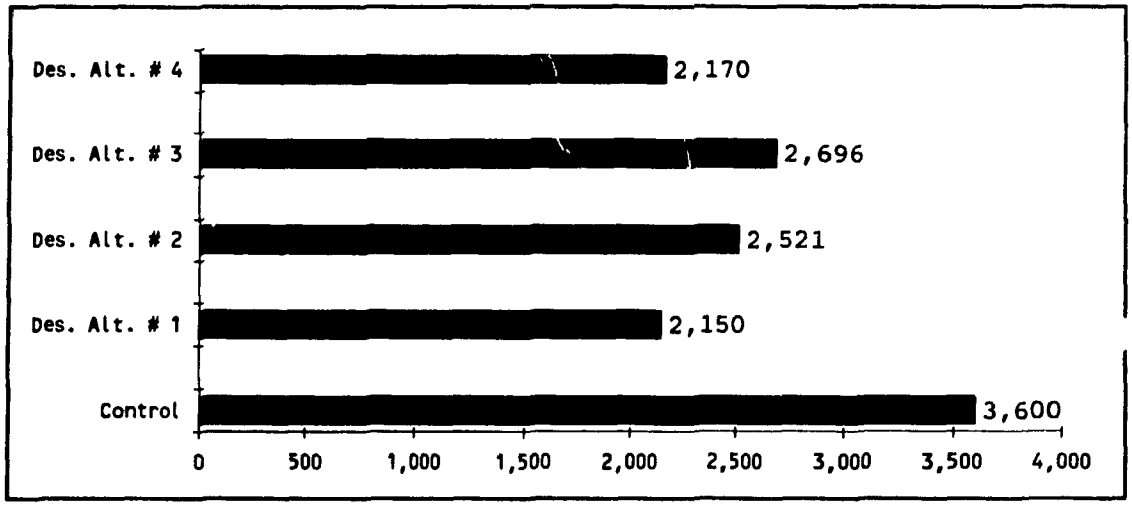

FIGURE NO.90 - COMPARISON OF PAVED AREAS

	CONTROL PLAN			DESIGN OPTION #		
LAND-USE	Areas	% of Total Site Area	Comparative Analysis	Areas	% of Total Site Area	C A
Circulation	4,656 M2	24.54%	-	3,519 M2	18.55%	
Public Open Spaces	2,886 M2	15.22%	-	2,265 M2	11.94%	
House Extensions	0	0	-	1,758 M2	9.26%	
Private Areas(plots)	11,424 M2	60.24%	-	11,424 M2	60.25%	
TOTAL	18,966 M2	100%	-	18,866 M2	100%	
Infrastructure	Quantity		Comparative Analysis	Quantity		Comparat Analysis
Water Supply	1,333 mts		-	1,382 mts		↑
Sewage	983 mts		-	1,237 mts		↑ 2
Manholes	53 units		-	78 units		↑ 4
Electricity	933 mts		-	1,180 mts		↑ 2
Poles & Street Lamps	44 units		-	55 units		↑ 2
Paving	3,360 M2		-	2,150 M2		↓ 4

PLAN		DESIGN OPTION #1			Design Option #2		
al a	Comparative Analysis	Areas	% of Total Site Area	Comparative Analysis	Areas	% of Total Site Area	Comparative Analysis
%	-	3,519 M2	18.55%	↓ 24.4%	4,164 M2	21.95%	↓ 10.56%
%	-	2,265 M2	11.94%	↓ 21.5%	1,884 M2	9.93%	↓ 34.72%
	-	1,758 M2	9.26%	-	1,494 M2	7.87%	↓ 15.01%
%	-	11,424 M2	60.25%	-	11,424 M2	60.25%	-
	-	18,866 M2	100%	-	18,966 M2	100%	-

omparative nalysis	Quantity	Comparative Analysis	Quantity	Comparative Analysis
-	1,382 mts	↑ 3.60%	1,443 mts	↑ 7.62%
-	1,237 mts	↑ 25.80%	1,208 mts	↑ 18.62%
-	78 units	↑ 47.16%	75 units	↑ 40.51%
-	1,180 mts	↑ 26.47%	1,087 mts	↑ 13.77%
-	55 units	↑ 25.00%	47 units	↑ 6.38%
-	2,150 M2	↓ 40.27%	2,521 M2	↓ 29.97%

	Design Option #2			Design Option #3			
rative sis	Areas	% of Total Site Area	Comparative Analysis	Areas	% of Total Area	Comparative Analysis	Areas
4.4%	4,164 M2	21.95%	↓ 10.56%	4,219 M2	22.24%	↓ 9.38%	3,734 M
1.5%	1,884 M2	9.93%	↓ 34.72%	2,283 M2	12.05%	↓ 20.89%	2,190 M
-	1,494 M2	7.87%	↓ 15.01%	1,040 M2	5.48%	↓ 40.84%	1,618 M
-	11,424 M2	60.25%	-	11,424 M2	60.23%	-	11,424
-	18,966 M2	100%	-	18,966 M2	100%	-	18,966

	Quantity	Comparative Analysis	Quantity	Comparative Analysis	Qu
%	1,443 mts	↑ 7.62%	1,466 mts	↑ 9.97%	
)%	1,208 mts	↑ 18.62%	1,158 mts	↑ 15.11%	
)%	75 units	↑ 40.51%	64 units	↑ 17.18%	4
%	1,087 mts	↑ 13.77%	1,063 mts	↑ 12.22%	1,
%	47 units	↑ 6.38%	48 units	↑ 8.33%	7
%	2,521 M2	↓ 29.97%	2,696 M2	↓ 25.11%	2

CONTROL PLAN			DESIGN OPTION #1			Design Opt	
reas	% of Total Site Area	Comparative Analysis	Areas	% of Total Site Area	Comparative Analysis	Areas	% of Total Site Area
56 M2	24.54%	-	3,519 M2	18.55%	↓ 24.4%	4,164 M2	21.95%
86 M2	15.22%	-	2,265 M2	11.94%	↓ 21.5%	1,884 M2	9.93%
	0	-	1,758 M2	9.26%	-	1,494 M2	7.87%
424 M2	60.24%	-	11,424 M2	60.25%	-	11,424 M2	60.25%
966 M2	100%	-	18,866 M2	100%	-	18,966 M2	100%

Quantity	Comparative Analysis	Quantity	Comparative Analysis	Quantity	Comp Anal
1,333 mts	-	1,382 mts	↑ 3.60%	1,443 mts	
983 mts	-	1,237 mts	↑ 25.80%	1,208 mts	
53 units	-	78 units	↑ 47.16%	75 units	
933 mts	-	1,180 mts	↑ 26.47%	1,087 mts	
44 units	-	55 units	↑ 25.00%	47 units	
3,360 M2	-	2,150 M2	↓ 40.27%	2,521 M2	

ESIGN OPTION #1		Design Option #2			Design Option #3		
of Total ite Area	Comparative Analysis	Areas	% of Total Site Area	Comparative Analysis	Areas	% of Total Area	Compa Analy
18.55%	↓ 24.4%	4,164 M2	21.95%	↓ 10.56%	4,219 M2	22.24%	↓ 9
11.94%	↓ 21.5%	1,884 M2	9.93%	↓ 34.72%	2,283 M2	12.05%	↓ 2
9.26%	-	1,494 M2	7.87%	↓ 15.01%	1,040 M2	5.48%	↓ 4
60.25%	-	11,424 M2	60.25%	-	11,424 M2	60.23%	
100%	-	18,966 M2	100%	-	18,966 M2	100%	

	Comparative Analysis	Quantity	Comparative Analysis	Quantity	Comparative Analysis
s	↑ 3.60%	1,443 mts	↑ 7.62%	1,466 mts	↑ 9.9
s	↑ 25.80%	1,208 mts	↑ 18.62%	1,158 mts	↑ 15.1
s	↑ 47.16%	75 units	↑ 40.51%	64 units	↑ 17.1
s	↑ 26.47%	1,087 mts	↑ 13.77%	1,063 mts	↑ 12.2
s	↑ 25.00%	47 units	↑ 6.38%	48 units	↑ 8.3
2	↓ 40.27%	2,521 M2	↓ 29.97%	2,696 M2	↓ 25.1

	Design Option #3			DESIGN OPTION #4		
parative lysis	Areas	% of Total Area	Comparative Analysis	Areas	% of Total Site Area	Comparative Analysis
10.56%	4,219 M2	22.24%	↓ 9.38%	3,734 M2	19.68%	↓ 19.8%
34.72%	2,283 M2	12.05%	↓ 20.89%	2,190 M2	11.55%	! 24.12%
15.01%	1,040 M2	5.48%	↓ 40.84%	1,618 M2	8.54%	↓ 7.96%
-	11,424 M2	60.23%	-	11,424 M2	60.23%	-
-	18,966 M2	100%	-	18,966 M2	100%	-

	Quantity	Comparative Analysis	Quantity	Comparative Analysis
2%	1,466 mts	↑ 9.97%	885 mts	↓ 33.60%
52%	1,158 mts	↑ 15.11%	784 mts	↓ 20.24%
51%	64 units	↑ 17.18%	43 units	↓ 18.86%
7%	1,063 mts	↑ 12.22%	1,305 mts	↑ 28.50%
8%	48 units	↑ 8.33%	71 units	↑ 38.02%
7%	2,696 M2	↓ 25.11%	2,170 M2	↓ 39.72%

CONCLUSIONS

The findings of this thesis are divided into three areas: 1. the general planning process, 2. the findings, which are divided into: a. land-use, and b. the infrastructure, and 3. suggestions regarding the use of the planning guidelines.

1. THE GENERAL PLANNING PROCESS

The first three chapters of this thesis examined the general planning principles involved in the design of sites and services projects. In these chapters, it is observed that planning approaches to low-income housing stress economic efficiency as the main determinant for project design, and that these economic concerns have led to the world-wide adoption of the grid plan. It is also observed that this type of planning approach, represented by the control plan, is usually deficient in its environmental quality. For example, in traditionally planned sites and services projects, large centrally located open spaces, such as the one illustrated in figure No.11, tend to remain unused and abandoned. Additionally, streets in this type of project do not support, nor encourage, the multiple activities that take place in the streets of unplanned settlements, given that they are strictly designed as circulation channels. This situation can be substantially improved by new approaches to area planning. The introduction of new alternatives, such as the planning guidelines, can match the level of economic efficiency of the grid plan, and at the same time provide a good living environment.

This study demonstrates that by following a simple set of standards

or planning guidelines that are more in tune with those observed in unplanned settlements, it is possible to significantly improve the land-use efficiency. Careful consideration must be given, however, to both physical and economic factors.

The initial planning strategy followed in this thesis, represents a contrary approach to the traditional design of sites and services projects; this is to say that, instead of concentrating solely on economic efficiency, the stress is put primarily on improving the environmental quality of the neighbourhood by following the guidelines. The first case study, design alternative # 1, demonstrated that a significant improvement in land-use efficiency could be achieved over the control plan. Penalties, however, were paid in terms of infrastructure. The process which followed after this first design alternative searched for a carefully balanced solution between economic and physical variables. Throughout this process, it became clear that all round savings may not always be possible. The design process, however, is a complex exercise where trade-offs among various alternatives and variables can be made. For example, it can be argued that savings in road paving, if large enough, can compensate for increases in electricity and extra sewers.

It was also found that in order to arrive at a more economic and environmentally sound solution, it is more efficient to start the planning process by developing controlled and progressive design alternatives. This involves modifying the grid plan by the gradual incorporation of the guidelines. The physical and economic benefits of this approach are evident, as was demonstrated in design alternative

4. In this case, significant cost reductions were made by decreasing quantities of infrastructure. This last design alternative demonstrated that if careful consideration is given to both, economic and physical variables, it is possible to achieve more efficient and responsive environments at no additional cost.

2. THE FINDINGS

The findings have been organized around the two main physical aspects of sites and services that were assessed in this study: land-use and infrastructure efficiency.

2.1 Land-Use

It was observed that the four design alternatives, while keeping a constant private area, achieved greater efficiency than the control plan in the percentage of land destined for semi-private use. In fact, all the design alternatives presented a significant decrease in the quantity of land devoted for circulation areas, and an increase in areas for house extensions. The importance of this achievement is that areas for house extensions tend to be more actively used for household, commercial, and work activities, thus assuring a higher value of land-use.

2.1.1 Circulation

Design alternatives # 1 and 4 produced the largest reductions in areas for circulation, namely reductions of 24.4% and 19.8% were achieved over the control plan. Design alternatives # 2 and 3 also

reduced circulation areas, although these were less efficient than alternatives # 1 and 4. The net reductions over the control plan in design alternatives # 2 and 3 were 10.56% and 9.38% respectively.

2.1.2 Open Spaces

In comparison to the control plan, areas for public open spaces decreased from 20.89% in design alternative # 3 to 34.71% in design alternative # 2. In design alternatives # 1 and 4 the reduction were of 21.51% and 24.12% respectively. But, in spite of these reductions, it was felt that: (a) by providing open spaces more in accordance with the spatial requirements and the activities of the people living in low-income areas, and (b) by achieving a more efficient distribution of public open areas within the neighbourhood, a higher usefulness of the land would be achieved.

2.1.3 House Extensions

Given that no provisions were made in the control plan in regard to areas for house extensions, all evaluations were made vis-a-vis design alternative # 1 which was the most efficient neighbourhood plan in this regard. In design alternative # 3 areas for house extensions decreased by 40.84% and in design alternatives # 2 and 4 by 15.01% and 7.69% % respectively. However, in contrast with the control plan, all four design alternatives offered opportunities for house extensions.

2.2 Infrastructure Efficiency

Here, an attempt is made to establish a correlation between the

planning guidelines and their effect on the quantities of infrastructure. The conclusions reached for the infrastructure studied are as follows:

2.2.1 sewage disposal and number of manholes

A. Short dead-end lanes, and self-contained clusters, tend to increase the length of sewage and the number of manholes. One explanation for the increase of quantities of sewage could be that each dead-end lane requires to be served individually. This characteristic not only increases the total network's length, but also the total number of manholes. Each sewer line serving a dead-end lane requires a minimum of two manholes: one at the intersection with the main collecting line, and another at the end of the lane, as seen in figure No.46. Self-contained clusters, having only one access, operate similarly to dead-end lanes, and have to be served by a single branch which demands a minimum of three to four manholes, as illustrated in figure No.26 . However, the number of manholes required in either case depends primarily on the size and configuration of the cluster.

B. Given that sewer lines are laid out on public land, preferably along the streets, and given that manholes need to be located at each change of direction in the line, the use of twists and turns in the access road usually increase the total length of sewers as well as the number of manholes.

C. This study showed that by reducing and, or, modifying the use of the guidelines relative to the use of dead-end lanes and self-

contained clusters, the length of sewers can be reduced and the number of manholes can be substantially decreased.

D. Design alternative # 4 provides the most efficient sewage disposal system. In it, major gains were made over the control plan as well as over design alternatives # 3, 2, and 1. Reductions of 20.24%, 32.29%, 35.1%, and 36.62% were respectively achieved in the total length of the sewers. In this case, significant savings were made in the total number of manholes required against the control plan.

E. Design alternative # 4 also evidenced significant savings in the total number of manholes when compared to all the other design options, including the control plan. Reductions of 18.86%, 32.81%, 42.66%, and 44.87% were respectively made against the control plan and design alternatives # 3, 2, and 1.

2.2.2 Electricity and street lighting

In relation to the length of the electrical networks and number of poles and street lamps it was observed that:

A. No design alternative could match the efficiency showed by the control plan. Design alternatives # 2 and 3, however, with increases of 13.77% and 9.91% over the control plan, were the most efficient electrical networks. Design alternatives # 1 and 4 showed increases of 26.47% and 28.5%.

B. The use of the guidelines exact penalties in the total length of the electrical network. i.e. for design alternatives # 1, 2, and 3 there is an average increase of 18.8% in the total length over the control plan. This increase came about by the number of turns

in the line required by each design alternative. It was noted that the length of the electrical network decreased as the layouts of the design alternatives became more regularized and conventional.

C. The number of poles and street lamps required in design alternatives # 2, and 3, matched the results achieved by the control plan, as illustrated in figure No.78. However, penalties were paid in design alternatives # 1, and 4, primarily because of the need to provide street lamps in all street widenings, and in a large numbers of small squares and dead-end lanes.

D. The net increases in the number of poles and street lamps in design alternatives # 4, 3, 2, and 1 against the control plan were of 38.02%, 8.33%, 6.38% and 25% respectively.

2.2.3 Water supply

A. The use of the guidelines did not increase the length of the water supply network in any major way. Substantial savings, however, were made in design alternative # 4. All the other design options achieved practically the same results as the control plan. The total savings over the control plan in design alternative # 4 were of 33.6%.

2.2.4 Street paving

A. The use of the guidelines produced significant savings in paving circulation areas. Consequently, major overall savings resulted from the use of any one of the four design alternatives in

comparison with the control plan.

B. Reductions of 39.72%, 25.11%, 29.97% and 40.27% were respectively achieved by design alternatives # 4, 3, 2, and 1 over the control plan.

Summing up, throughout the study of the four design alternatives, it was observed that all design options achieved greater land-use efficiency than the control plan by reducing circulation and by allocating a higher proportion of land toward semi-public use. In terms of infrastructure, all design alternatives matched the efficiency of the control plan for water supply while achieving major reductions in street paving. Sewage and electrical network if carefully calculated can help to work out a balanced trade-off.

3. SUGGESTIONS REGARDING THE USE OF THE GUIDELINES

This final section presents in point form the main findings which led to the reductions achieved in design of the alternative # 4. These findings are:

1. The use of self-contained clusters, and dead-end lanes can cause large infrastructure increases. Specially with regard to the provision of sewage.
2. Twists and turns in the main access road, and secondary streets should not be big. Severe changes in direction can cause significantly increases in the quantity of infrastructure. By

introducing just slight changes it is possible to achieve layouts which can be very good in terms of land-use efficiency and infrastructure.

3. The use of a large number of major street widenings, usually 3 to 5 meters wide, can cause large increments in the length of the electrical network and in the quantity of poles and street lamps given that each widening requires individual illumination.

4. Throughout the implementation of the guidelines, it was found that in order to obtain more efficient results, it is better to start the planning process by developing controlled and progressive design alternatives based on the gradual modification of a grid plan and gradually incorporating as many guidelines as possible. The physical and economic benefits of this process are evident, as it was demonstrated in the design alternative # 4 where significant cost savings where achieved by reducing quantities of infrastructure.

It is believed, and expected, that by using these findings, planners and designers will be in a position to make more efficient use of the guidelines and at the same time achieve more humane urban environments for people living in low-income areas.

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APPENDIX ONE

HUMAN SETTLEMENTS TRAINING PACKAGES

PLANNING GUIDELINES

CENTRE FOR MINIMUM COST HOUSING, MC GILL UNIVERSITY, MONTREAL

VASTU-SHILPA FOUNDATION, AHMEDABAD.

NOTES TO PARTICIPANTS

The purpose of these Human Settlements Training Packages is to provide material that can be used to introduce architects, planners and urban designers to new ideas for planning low-income urban housing that is more responsive to the demands of users, that is more effective at providing a good living environment, and that reflects a sensitivity to the lifestyle of the urban poor.

Each of these Training Packages consists of several Slide-Sound Presentations, that are accompanied by a "Participant's Folder" that includes "Presentation Text," "Questions and Topics for Discussion," and a "Practical Exercise."

There are three steps in using the Training Package:

1. Viewing the Slide-Sound Presentation.
2. At the end of each presentation there is a Discussion Period, based on the questions and topics provided in each Participant's Folder.
3. At the end of the Training Package there is a Practical Exercise, done individually, or in groups.

The first Training Package in this series deals with issues related to the planning and design of public spaces in low-income, urban housing projects. It is entitled "Design Guidelines," and consists of seven Slide-Sound presentations:

1. Introduction
2. Neighborhood Streets
3. Workplaces
4. Small Shops
5. Trees and Public Spaces
6. House Extensions
7. Using the Guidelines

Other training Packages are either planned, or in the process of preparation. They include "Upgrading Slums," "Sites and Services Projects," and "The Aranya Project."

For information, or to order additional packages contact:

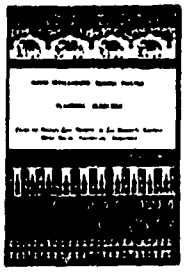
Centre for Minimum Cost Housing
McGill University
Macdonald-Harrington Building
815 Sherbrooke Street West
Montreal, QC, Canada H3A 2K6
Tel: (514) 398-6722

Vastu-Shilpa Foundation
Sangath
Thaltej Road
Ahmedabad 380 054
India
Tel: (272) 445670

This training package was prepared by Shachi Atree, Vikram Bhatt, Yatin Pandya, Witold Rybczynski, Utpal Sarma, and Roberto Torres.

Introduction

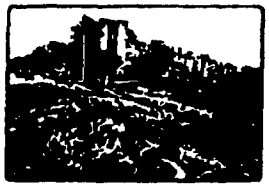
1. INTRODUCTION



1. This presentation is part of a comprehensive set of training materials prepared by a cooperative effort of the Vastu-Shilpa Foundation, Ahmedabad, and the Centre for Minimum Cost Housing of McGill University, Montreal.

2. This series of slides serves as an introduction to a group of training packages that deal with planning guidelines for public spaces in low income urban housing.

3. As a result of the extraordinary growth of Indian cities and towns, the shelter problems of the urban poor have increased in scale, and in severity.



4. Conventional resources have become strained to the limit as federal, state and municipal authorities struggle to deal with this new problem.

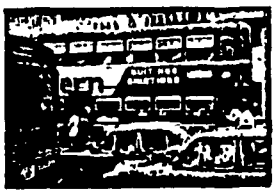
5. In most urban areas there is a proliferation of slums and squatter settlements as the poor attempt to solve their shelter problems.

6. These unplanned settlements are characterized by a lack of adequate infrastructure and urban services.

7. Water shortages are typical, and it is not uncommon to see long lines in front of public water taps.

8. The disposal of human excreta is often hazardous, and results in environmental pollution and unhealthy surroundings.

9. A growing urban population and changing patterns of consumption create larger amounts of solid waste that must be disposed of.



10. Excessive pressure is put on the municipality to provide good roads and effective mass transportation.

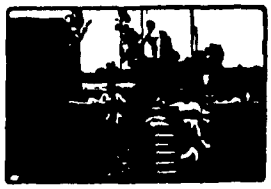
11. Faced with these growing problems, municipal governments have been forced to explore new ways of stretching limited housing budgets.

12. Sites and services projects represent one approach to the provision of housing that encourages a large degree of self-help and participation on the part of the urban poor.

13. Upgrading existing slums and squatter settlements is another strategy for using the limited financial resources in a more cost-effective way.

14. Both of these approaches need a greater awareness of the resources, requirements, and way of life of the urban poor on the part of housing administrators, architects, planners and engineers.

15. A new set of settlement standards needs to be evolved which seeks to accomodate, rather than to reorganize, which responds to social needs, which recognizes traditional living patterns, and which produces living environments that are not only affordable, but also culturally appropriate.



16. In both sites and services projects and slum upgrading, the actual house design and construction is undertaken by the users themselves. This implies a change in the traditional role of architects and planners.

17. The main involvement of design professionals in planning housing for the Economically Weaker Sector is not primarily in designing housing but in laying out plots, and in determining the layout and nature of the public spaces: the streets and open areas.

18. The slide presentations that you are about to see have been organized into five packages, that will examine five different aspects of the use and design of public space in low-income urban housing.

19. Neighborhood streets deals with the different types of streets and open spaces, and their size and use.

20. Work places describes the wide range of commercial activities that need to be accomodated in the space of the street.

21. Small shops depicts the various ways in which small-scale shops are integrated into the housing environment.

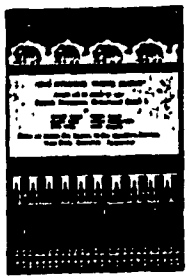
22. Trees and public spaces reminds us how trees can be used to improve the quality of the public realm.

23. House extensions shows the many ways in which the home extends into the street, and how these important spaces are used.

24. The information presented in these packages is based on research carried out in several urban settlements, both planned and unplanned.

25. Each of the packages concludes with suggested Design Guidelines. The sixth package suggests examples of how these Guidelines can be used in practice.

26. With the information provided by this series of slide presentations, administrators, planners, architects and engineers will see how following planning guidlines can simply and inexpensively improve the enviromental and social quality of low-income urban housing.



27. This training package has been prepared with the support of the Canadian International Development Agency. For further information please contact the Vastu-Shilpa Foundation, Ahmedabad, or the Centre for Minimum Cost Housing, McGill University, Montreal.

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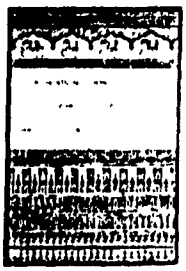
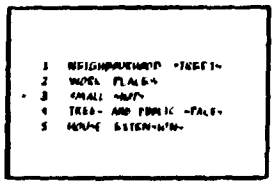
Using The Guidelines

7. USING THE GUIDELINES



1. This presentation is part of a comprehensive set of training materials prepared by a co-operative effort of the Vastu-Shilpa Foundation, Ahmedabad and the Centre for Minimum Cost Housing of McGill University, Montreal.

2. This series of slides describes several design guidelines and how architects and planners can use them to improve the environmental qualities of low-income housing.

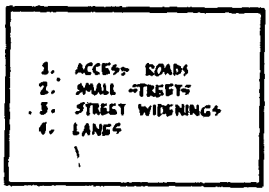


3. The guidelines cover five subjects:

- 1. Neighborhood Streets
- 2. Work Places
- 3. Small Shops
- 4. Trees and Public Spaces, and
- 5. House Extensions

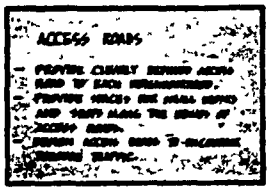
4. (Title) Neighborhood Streets

5. Streets are not only used for circulation and access to homes, but are also places for social and cultural interaction. They are a key element in organizing a settlement plan.

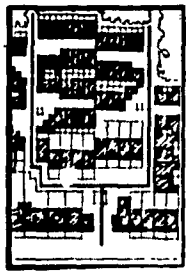


6. Streets can be classified into four categories, according to their physical character and use:

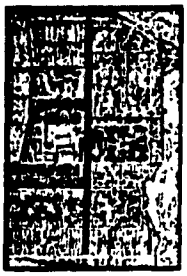
- 1. Access Roads
- 2. Small Streets
- 3. Street Widenings
- 4. Lanes



7. The guidelines for designing access roads are:
   - provide a clearly defined access road to each neighborhood,
   - provide space for small kiosks and shops along the edges of access roads, and
   - design access roads to discourage through traffic.

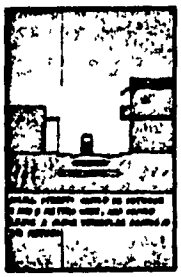


8. This illustration shows an effective design for access roads. Notice how the entry to the neighborhood is restricted to a single point, discouraging traffic from passing through the neighborhood.

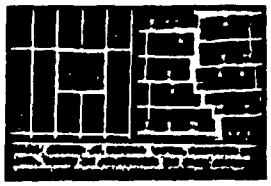


9. In this low-cost housing project from Madras, the settlement is organized around one main access road. All public facilities such as bus stands, communal and commercial spaces, and a clinic and daycare center are located along this road.

10. Small streets give access to individual houses. But, in addition to providing circulation space for pedestrians and vehicles, they also contain a variety of household and social activities.

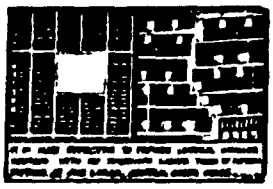


11. Small streets should be between 4 and 5 meters wide and should leave a clear vehicular access of 2.5 meters.



12. The plan on the right shows neighborhood streets of varying widths, connected by lanes, rather than the rigid grid layout on the left.

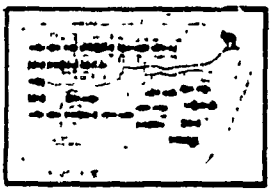
13. Street widenings are small, open spaces that are expansions of the street. Their scale and location should be carefully considered.



14. It is more effective to provide several smaller squares, with no dimension larger than 15 meters, instead of one large, central green space.

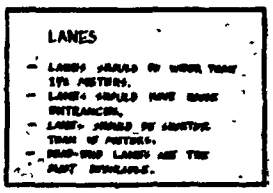
15. Provide small street widenings of about 2 to 5 meters wide, to be used as public outdoor rooms for socializing at the cluster level.

16. Enlarge street intersections, so that they provide small spaces for hawkers, small shops or workplaces.



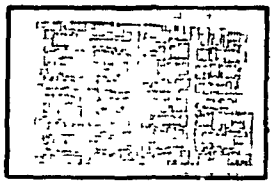
17. This housing design in Bareilly demonstrates the creative use of open spaces. Small street widenings create house clusters. These pockets are used either as work spaces or for domestic activities.

18. Lanes are the narrowest circulation links that connect small streets.



19. The guidelines for designing lanes are:

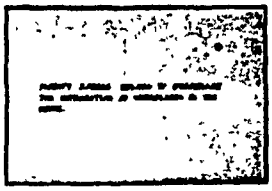
- lanes should be wider than 1.5 meters,
- lanes should have house entrances,
- lanes should be shorter than 15 meters, and
- dead-end lanes are the most desirable.



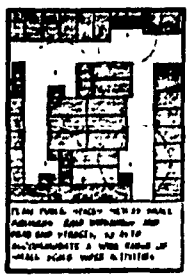
20. In this project, the dead-end streets combine many of the characteristics of lanes, although here they are slightly wider and longer.

21. (Title) Work Places

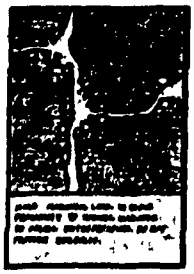
22. Low-income neighborhoods are not only places for living, but also places where a number of work activities occur. Spaces should be provided to accommodate a wide range of work activities in public areas and in close proximity to the home.



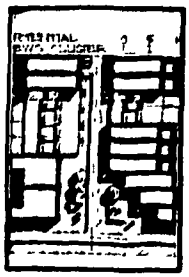
23. First of all, modify zoning by-laws to encourage the integration of work places in the home.



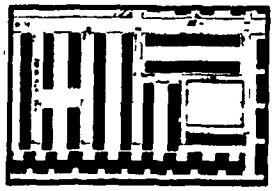
24. Plan public spaces such as small squares, road widenings and dead end streets, to accommodate a wide range of small-scale work activities. The spaces shown hatched can be used to set up informal workshops.



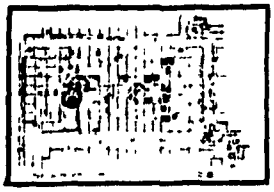
25. Make marginal land in close proximity to housing available to small entrepreneurs. Do not provide buildings.



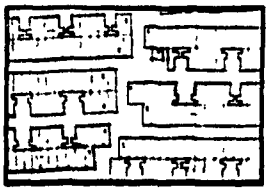
26. Extra land is set aside at the street intersection and can be used for a variety of small-scale work activities.



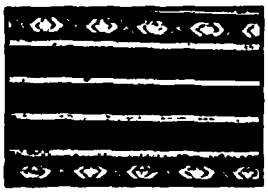
27. In this example from Kanpur, the small pocket of land on the left is kept open by eliminating six plots. This open space is intended for a work space or commercial use and is more effective for this purpose than the larger park space on the right.



28. The interior space in this housing cluster in Hyderabad is a well-designed work place.

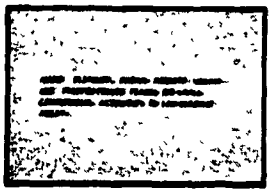


29. Here is another example of how work spaces can be incorporated with housing by removing one or two plots to make a slot for semi-public uses.



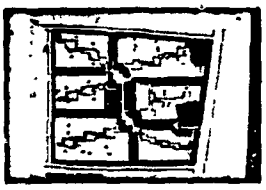
30. (Title) Small Shops

31. Traditionally, living and shopping areas have existed side by side. There is no conflict between small shops and homes, indeed, the integration of the two produces a more active and richer public environment.



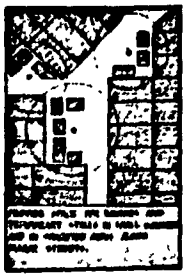
32. The first guideline concerned with small shops requires the designer to avoid planned, formal markets which are inappropriate places for small commercial activities in low-income areas.

33. Modify zoning regulations to allow house owners along major streets and at road junctions to convert a part of their home to commercial use.

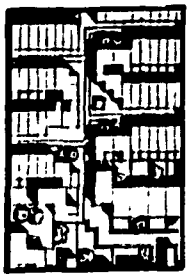


34. In the Aranya project in Indore, in addition to the central market (shown in black), families living along access roads (shown hatched) will be permitted to establish small shops.

35. Although no special provisions were made for shops along major roads in this resettlement project in New Delhi, notice how the ground floor and the spaces in front of houses have been modified for commercial use.

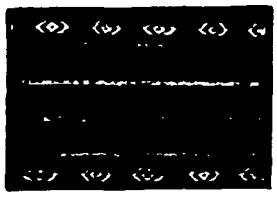


36. The final guideline for small shops calls for a space for hawkers and temporary stalls in small squares and in specified areas along major streets.



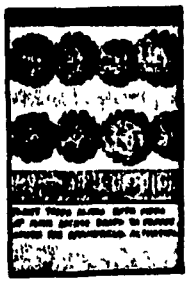
37. In this plan, space has intentionally been left vacant at the street intersection to permit hawkers to set up stalls along the main access road.

38. Such intersection spaces can be developed in a variety of ways.



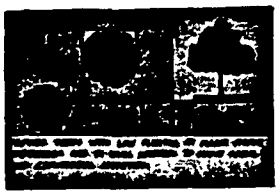
39. (Title) Trees and Public Spaces

40. Trees are a vital part of the built environment; their presence encourages a wide variety of social, cultural and work activities.

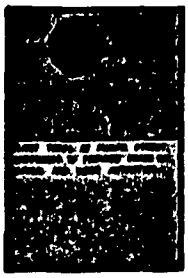


41. Plant trees along both sides of main access roads to provide shade for commercial activities.

42. In the Arambakkam project in Madras, the avenue of trees along the main access road enhances the stalls and shops.

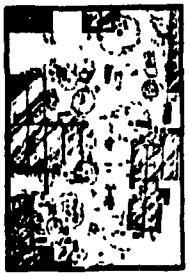


43. Provide trees with low plinths at major street widenings and in small squares to serve social and commercial activities.



44. Plant trees at minor street widenings to provide shade for social and work activities.

45. In this demonstration project, tree planting is considered to be an integral part of the urban infrastructure.

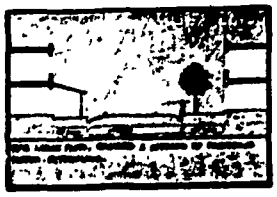


46. This drawing shows how the architects of a recently completed project have studied the effect of trees on a wide range of urban activities.

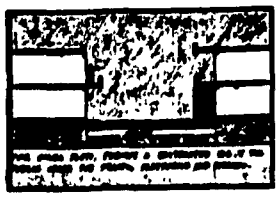
47. (Title) House Extensions

48. House extensions represent a transition zone between the street and the home. They are conducive to a variety of domestic and social activities. It is important to make provisions for house extensions regardless of the plot size, or of the housing density.

49. Provide space for house extensions varying in size from less than 1 meter to a maximum of 2 meters deep, depending on the street width, housing density and space available.



50. For large plots, require a setback to encourage house extensions.

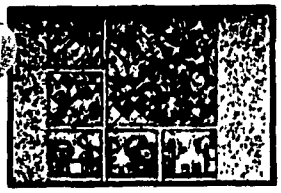


51. For small plots, permit a restricted use of the public space for stoops, platforms and porches.

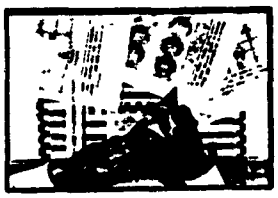
52. This study explores the effect of house extensions on the architectural character of the narrow-front house.

53. In this example from a sites and services project in Ahmedabad, plot owners were allowed a restricted use of the public space. Within a depth of one meter they could build stoops, platforms, open stairs and balconies. This has produced a lively and varied street front.

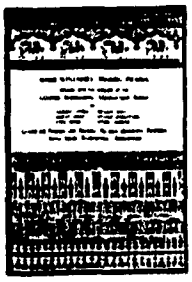
54. Here is another example of restricted use of street space for building house extensions in a sites and services project in Madras.



55. Using the guidelines regarding streets, shops, workplaces, trees, and house extensions, will produce a more human and a more successful housing environment, at little or no extra cost.



56. These training packages have shown some areas where the use of design guidelines by architects, engineers and planners could improve the living environment of low-income users.



57. This training package has been prepared with the support of the Canadian International Development Agency. For further information please contact the Vastu-Shilpa Foundation, Ahmedabad, or the Centre for Minimum Cost Housing, McGill University, Montreal.

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7. USING THE GUIDELINES - Practical Exercise

The following exercise is intended to provide an opportunity for participants to see how the Design Guidelines could be used in practice.

The attached Neighborhood Plan shows 504 housing plots (3m x 7m). There are four green spaces as well as a shopping area. The small streets are all 5m wide; the lanes are 3m wide. The surrounding streets are 7m, 9m, and 13m wide.

1. Place a sheet of tracing paper over the plan and try to replan the layout by redistributing the large green spaces throughout the neighborhood (see Guideline No.7). It is not necessary to make radical changes to the existing layout.

2. Modify the lanes according to Guideline No.1.

3. Provide a clearly defined access road, according to Guideline No.4.

4. Develop the street intersections according to Guideline No.6; make street widenings according to Guideline No.5.

5. Can you redistribute the Shopping Area throughout the neighborhood according to Guideline No.11?

6. Do you think that the open spaces that you have provided can respond to Guidelines Nos.9, and 12?

7. Where is the best place to plant trees in this new plan? Consult Guidelines Nos.14, 15, and 16.

8. How does this plan compare with the original? Do you think that such improvements are feasible?

HUMAN SETTLEMENTS TRAINING PACKAGES

DESIGN GUIDELINES

Neighborhood Streets

1. -- Lanes should be wider than 1.5 meters,
   -- Lanes should have house entrances,
   -- Lanes should be shorter than 15 meters,
   -- Dead-end lanes are the most desirable.

2. Small streets should be between 4 and 5 meters wide, and should leave a clear vehicular access of 2.5 meters.

3. Small streets of varying widths, connected by lanes, should be substituted for rigid, gridiron layouts.

4. -- Provide a clearly defined access road to each neighborhood,
   -- Provide space for small kiosks and shops along the edges of access roads, and
   -- Design access roads to discourage through traffic.

5. Provide small street widenings, about 2-5 meters wide, to be used as public outdoor rooms for socializing at the cluster level.

6. Enlarge street intersections so that they provide small spaces for hawkers, small shops or workplaces.

7. It is more effective to provide several smaller squares, with no dimension larger than 15 meters, instead of one large, central green space.

Workplaces

8. Modify zoning bylaws to encourage the integration of workplaces in the home.

9. Plan public spaces such as small squares, road widenings, and dead end streets, so as to accommodate a wide range of small-scale work activities.

10. Make marginal land, in close proximity to housing, available to small entrepreneurs. Do not provide buildings.

Small Shops

11. Avoid planned, formal markets which are inappropriate places for small commercial activities in low-income areas.

12. Provide space for hawkers and temporary stalls in small squares and in specified areas along major streets.

13. Modify zoning regulations to allow house-owners along major streets and at road junctions to convert a part of their home to commercial use.

Trees and Public Spaces

14. Plant trees along both sides of main access roads to provide shade for commercial activities.

15. Provide trees with low plinths at major street widenings and in small squares to serve social and commercial activities.

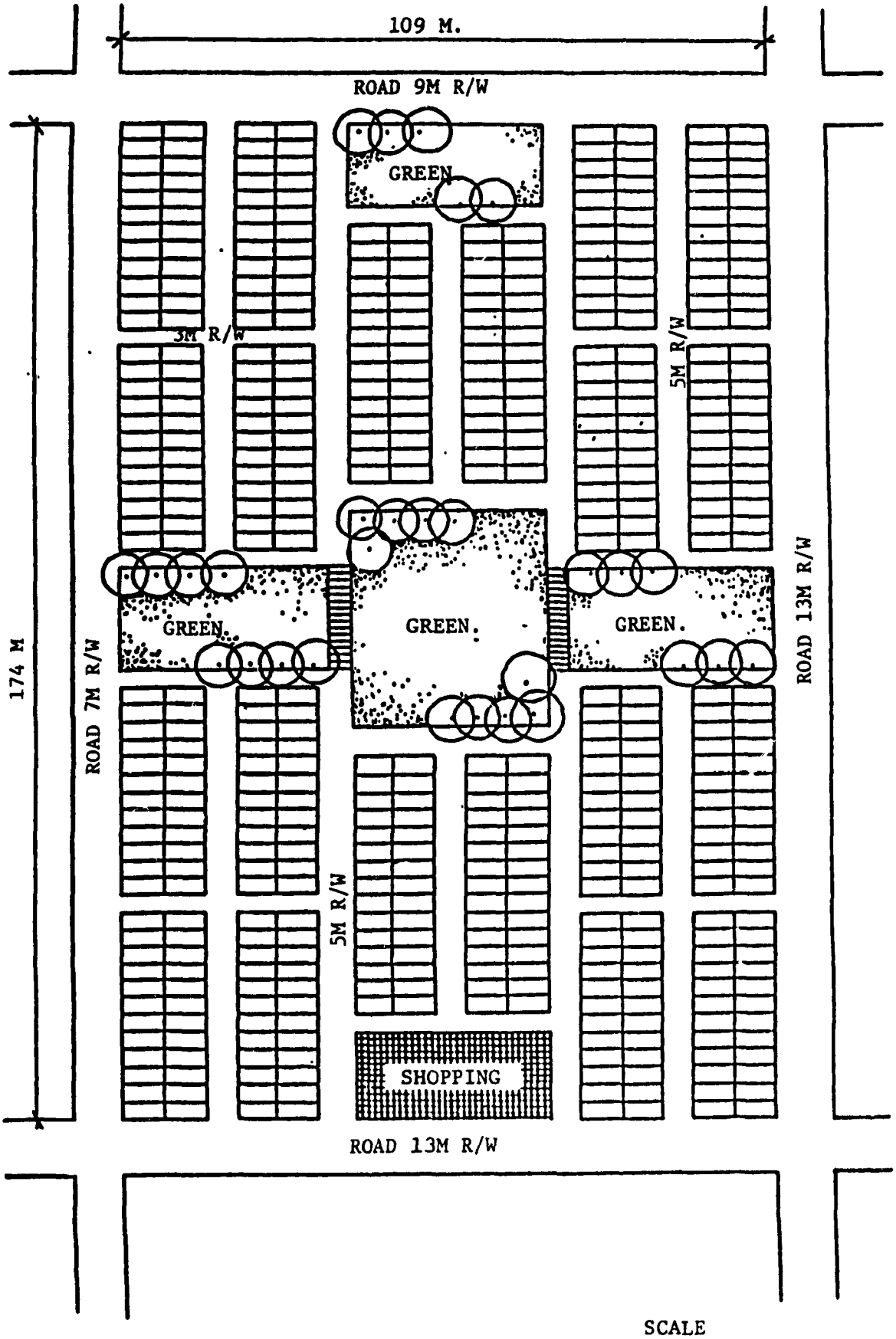
16. Plant trees at minor street widenings to provide shade for social and work activities.

House Extensions

17. Provide space for house extension, varying from less than one meter to a maximum of two meters, depending on street width, housing density and space available.

18. For large plots, require a setback to encourage house extensions.

19. For small plots, permit a restricted use of the public space for stoops, platforms and porches.



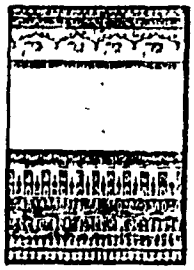
SCALE

0 3 6 9 12 19 22 27 32 M.

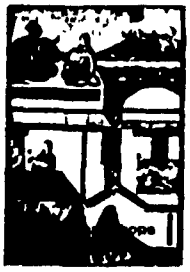
NEIGHBOURHOOD PLAN.

Small Shops

4. SMALL SHOPS



1. This presentation is part of a comprehensive set of training materials prepared by a cooperative effort of the Vastu Shilpa Foundation, Ahmedabad, and the Centre for Minimum Cost Housing of McGill University, Montreal

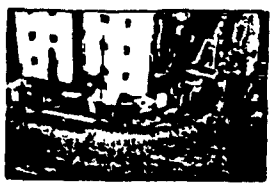


2. This series of slides describes the physical characteristics of small shops, their locations, and their relationship to housing

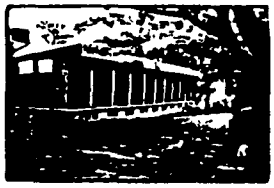
3. Commercial activities have traditionally been combined with housing, a situation which continues to exist in many older urban neighborhoods.

4. It is no accident that shopping and living activities also exist side by side in most slums and unplanned settlements.

5. It is only in modern, planned housing projects that we find large housing areas without any provision for small shops and commercial activities.



6. As a result, it is not uncommon to see improvised, shopping areas spring up along major roads and on street corners. Because sufficient space has not been set aside, they block the sidewalks and obstruct traffic.



7. But centralized, formal shopping centers are not a solution. In this market, erected by the municipal authority, the rent is too expensive for the small shop owners, and the stalls stand empty.

8. A successful solution to the provision of shopping facilities in low-income, urban areas, must recognize that small shops have several specific advantages that suit the lifestyle of people with minimal financial resources. Here are several examples, which illustrate this fact.

9. Two sisters have set up this little shop selling homemade rice rolls and fruit adjacent to their home. Notice how little is needed to operate this small business--only a ground cover made from old jute bags, and a bamboo basket.

10. This open-air vegetable stand is located on a platform, under the shade of a large tree. This entrepreneur uses his push-cart to transport the produce which he buys daily from a big market.

11. A corner room of this house has been converted to a grocery shop. Such small shops, which are found located throughout housing areas, fulfill an important function since low-income users are obliged to buy food daily, in small quantities.

12. Tea stalls are another type of commercial activity that is related to the scale of the neighborhood and are important places for socializing. Wooden benches are provided for sitting

13. Small shops sell a variety of products and are classified into two categories:

- shops that sell mainly commodities, and
- shops that provide mainly services.

14. (Selling commodities) Commodities used daily like vegetables and fruits are sold from push-carts, or along the roadside.

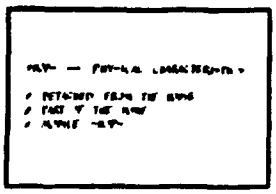
15. This kiosk sells day-to-day items like matches, beedies, soap, packets of tea and so on.

16. (Providing services) In addition to food and daily items, small shops also provide services directly to the community, like this ironing and laundry shop.

17. Roadside metalwork shops are set up to repair tools and kitchen implements.

18. This openair barber-shop requires a minimal investment--only two chairs and a bench.

19. Some shops sell both services and commodities like this permanent stall where sweets and other savouries are made.



20. Small shops can also be classified in terms of their physical character:

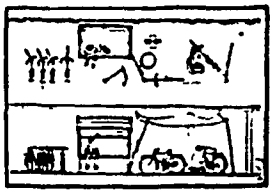
- shops that are detached from the house,
- shops that are a part of the home, and,
- mobile shops.

Now, let us look at each type.

21. (Detached shops) The street hawker represents the simplest form of detached shop; there is no physical structure at all. Under an umbrella, this locksmith has laid out his wares on the ground.

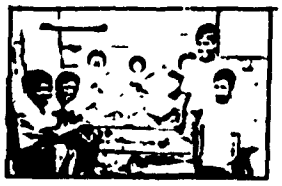
22. It is possible to set up a temporary shop, like this one selling potato chat, with the least possible investment.

23. In this makeshift shoe-repair stand, a bed is used as a screen from the busy street.

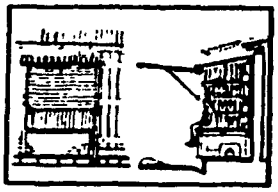


24. Even when a detached shop occupies a permanent site, it does not require a building. This bicycle repair shop, which provides a very important service to low-income users, is located on a busy street and uses an existing compound wall to support a canvas awning.

25. A more permanent shop of the detached type takes the form of a small kiosk. It could be as small as 2m X 1m like this paan shop.

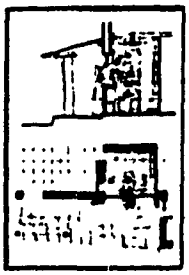


26. (Part of the home) The small shop is often incorporated into the home. Here the external wall of the house, becomes a display area for a small kite shop.



27. The shop-owner who sets up at home pays no rent. A part of the stoop of this house has been converted into a grocery shop.

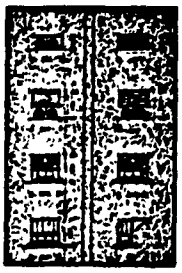
28. A corner tea shop is set up simply by providing a counter in the existing kitchen of a house.



29. In this house, an entire room has been converted into commercial space.

30. It is possible to convert the front room of a house into a small shop, like this one selling groceries.

31. A very large shop can occupy the entire ground floor of a house--the owners live above.



32. (Mobile shops) Mobile shops take many forms. The most typical being the four-wheel push-cart.

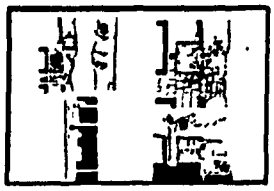
33. Push-carts are used for selling mainly fruits and vegetables.

34. The shop-on-wheels can move around the neighborhood, bringing its products directly to the customers. This man is selling cloth from the back of his bicycle.

35. Ice candies, appealing mainly to children, are sold from small refrigerated carts.

36. Not all mobile shops move around. This one is parked at a permanent location and its goods are displayed on the roadside.

37. The distinction between a mobile and a fixed shop sometimes becomes blurred; this paan shop on a push-cart has had its wheel removed and is parked at a permanent location.



38. The wheels of this push-cart have been replaced by a solid platform.

39. To summarize, small shops are characterized by:

- their small size,
- their proximity to homes, and
- their ability to cater to local needs.

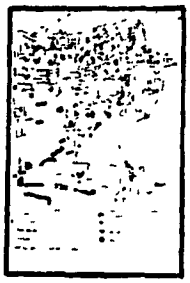
40. Small shops follow sound commercial principles in terms of how and where they are located. They are usually placed where there is the greatest exposure to passersby. Notice the number of shops on this main street.

41. Major roads are good locations for certain businesses like this one that makes and repairs push-carts.

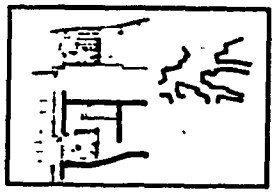
42. Public squares with platforms and shade-trees attract hawkers and roadside sellers.

43. Street corners are a good place for convenience stores and tea shops.

44. Even small streets within neighborhoods can support certain kinds of small shops.



45. This plan of a slum in the city of Indore indicates that the location of shops follows the hierarchy of streets, that is, larger shops locate on wider streets, and small shops on narrower streets. Notice that although most of the commercial activities are along the main road, a small number of shops is scattered throughout the settlement.

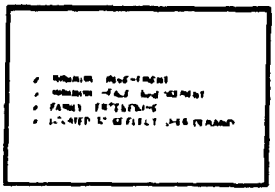


46. Small shops have various economic advantages over commercial centres and planned markets. When shopping and living activities are combined, one gives way to the other as the need arises, making optimal use of all available space.

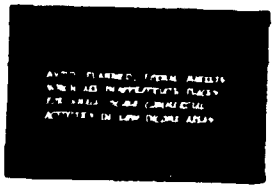
47. Owning and operating a small shop is an important addition to the family income.

48. The small scale of the family shop allows people to undertake commercial activities with very small resources. For example this shop is set up with only a dozen bananas.

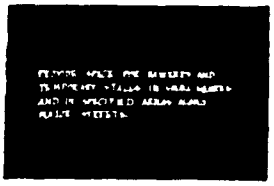
49. Different family members can run the shop at different times, when they are free, and hence provide many economic and social benefits.



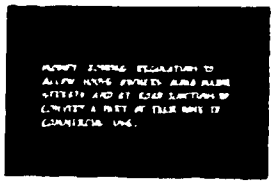
50. To summarize, the main advantages of small shops in low-income urban neighborhoods are:
- they can be started and operated with a minimum investment,
- they do not require much space,
- they encourage family enterprise, and
- they can be suitably located to reflect user demand.



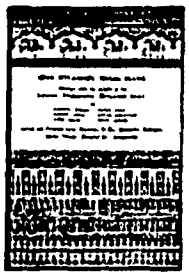
51. (Guideline) Avoid planned, formal markets which are inappropriate places for small commercial activities in low-income areas.



52. (Guideline) Provide space for hawkers and temporary stalls in small squares and in specified areas along major streets.



53. (Guideline) Modify zoning regulations to allow house-owners along major streets and at road junctions to convert a part of their home to commercial use.



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4. SMALL SHOPS - Questions and Topics for Discussion

1. Have you observed small shops in the neighborhood where you live? What kind of things do they sell? What kind of services do they provide?

2. Shopping and housing are often segregated in new townships. What is the reason for this separation?

3. Is there a certain scale of shops that should be permitted in housing areas? How could zoning restrictions be changed to permit such integration on a selective basis?

4. What is the reason that shops are frequently a part of the house? What are the advantages? What are the disadvantages?

5. Where are small shops usually located? Why? What is the least desirable location for a small shop?

6. Have you observed kiosks, stalls and sidewalk vendors? Where do they usually set up?

7. Do these kind of shops interfere with pedestrian and vehicular traffic? Is there a way in which this inconvenience could be reduced or eliminated?

8. Do you think that small shops should be incorporated into the design of housing neighborhoods? If yes, why? If no, why?

9. How is the design of streets and street widenings affected by the presence of small shops?

10. What are some of the differences between small shops and centralized markets? What are the differences for the shopper? Or for the shop owner?

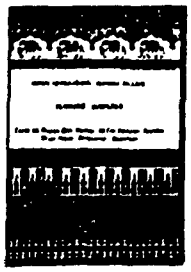
11. Do you agree that formal shopping markets are less efffective than decentralized small shops?

12. Do you think that all or some of the Design Guidelines which have been described in these Training Packages could be incorporated in future housing projects?

13. Is there something in this Training Package that you disagree with, or which doesn't accord with your experience?

Trees & Public Spaces

5. TREES AND OPEN SPACES



1. This presentation is part of a comprehensive set of training materials prepared by a cooperative effort of the Vastu Shilpa Foundation, Ahmedabad, and the Centre for Minimum Cost Housing of McGill University, Montreal.

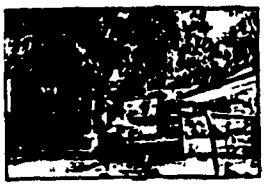
2. This series of slides describes trees and public spaces and their important role in the public environment.

3. Traditionally, trees have been considered the source of life and many social and religious activities are centered around them.

4. In most modern housing schemes no consideration is given to planting trees. As a result no matter how attractive the design may be, these settlements still lack many essential qualities.

5. Landscaping is usually considered to be a luxury in low cost housing, and the infrastructure that is provided is confined to underground networks of pipes, street lights, and electric distribution lines. Despite pucca houses, wide streets and efficient services, something is still missing.

6. The missing ingredient is...trees.



7. The presence of trees can improve even the poorest neighbourhood.

8. In contrast to many publicly-built housing projects, slums often contain large numbers of trees that are planted, maintained and protected by the inhabitants. They do this because trees serve several functions and support many domestic activities. Let us look at a few examples.

9. Trees provide defined and shaded space which can substitute for porches and verandahs. They can shelter various activities such as sleeping, sitting and community gatherings.

10. Household activities, such as washing clothes and cleaning kitchen utensils, are performed under the shade of a tree.

11. Tree trunks are useful as structural supports for drying clothes, and for building small lean-tos or house extensions.

12. It is a common practice to tie animals beneath shade trees.

13. The spaces beneath trees are often used to store household goods, protecting them from the sun and rain.

14. As well as providing shade in the hot summer months, pruned branches can provide fuel for cooking in winter.

15. The commercial value of fruit-bearing trees can be a substantial addition to the household income. Individual families maintain fruit trees like coconut, papaya and banana.

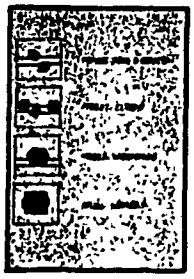
16. Shaded areas are useful not only for domestic activities, but also make comfortable work places. Here, rope makers are sitting under a tree at the edge of the street.

17. The areas around trees are a convenient place for hawkers, and small shops and stalls.

18. Trees have religious significance as well. Banyan, pipal and bili trees are usually associated with shrines and temples.

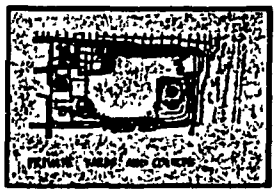
19. Trees certainly enrich the living environment but it is important to understand that the mere provision of trees is not enough; they must be well located. For example, this housing scheme in Delhi provides large open spaces with rows of eucalyptus trees but the area remains unused and wasted.

20. On the other hand, a single shade tree with an inexpensive, mud platform at a street widening is an attractive place for socializing. It is very important to understand where and how trees should be planted.

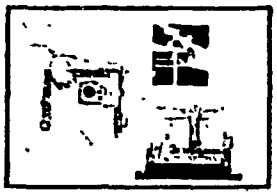


21. There are four locations where trees seem to perform a useful role in housing areas:

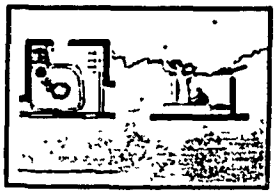
- private yards and courts,
- street curbs,
- street widenings, and
- small squares.



22. (Private yards and courts) People often plant shade, decorative or fruit trees in front of their houses and in small adjacent gardens.

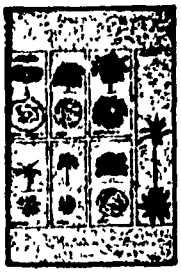


23. Beacuse of their close proximity to the house, trees planted in private yards are used only by individual families.

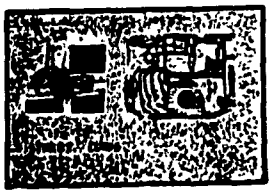


24. Trees with platforms can be a substitute for porches and outdoor rooms. Living and working activities take place here.

25. Trees in the front yard become physical supports for house extensions or for fastening ropes in order to dry laundry.



26. Banana, coconut, papaya, guava and chiku are fruit trees commonly found in small private yards; when more space is available it is not uncommon to see large trees like mango.

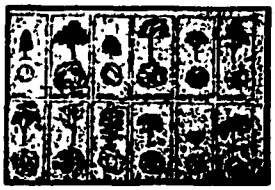


27. (Street curbs) Street curbs are another common place for planting trees.

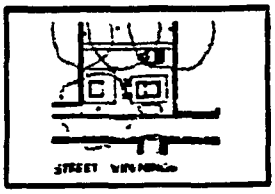
28. Even narrow streets can have rows of shade and decorative planting. Here we see a series of drumstick trees.

29. Streets wider than 5 meters require a double rows of trees.

30. Although they are a part of the public realm, these trees encourage more personal use since they are close to the house.



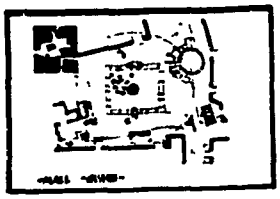
31. Species that are appropriate for street curbs are: asoka, mulberry, drumstick or gulmohar. They are decorative and provide good shade.



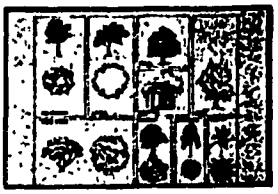
32. (Street widenings) The third common location for planting trees is at street widenings. This small pocket of land contains three shrines.

33. At such locations, a platform shaded by a tree can become a favourite place for meeting friends. Although the platforms are a part of the street, they remain undisturbed by the traffic.

34. The semi-public character of the platform is ideal for shrines and small temples that become an identifiable community space for the immediate neighbourhood.

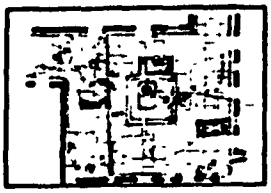


35. (Small squares) The fourth location for trees is in small public squares. Such squares occur occasionally in slums and unplanned settlements, and typically grow up around a large tree. The size of the square is often determined by the spread of the tree located in the centre.



36. Larger spaces demand larger species of shade trees, such as banyan, karanj, neem, palmira, pipal, tulip and coral.

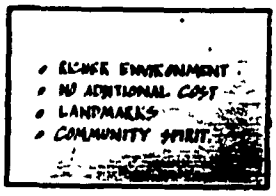
37. Such large trees often become landmarks, and the space around them is used by the whole community.



38. A centrally-located tree provides shade for nearby houses as well as becoming a central support for guy ropes and clothes lines. The platform serves as a sitting and resting place for young and old, passersby and hawkers.

39. In this example from Indore, a group of trees in a public square shades a platform that accommodates a community complex comprising three temples, seats and an exercise area.

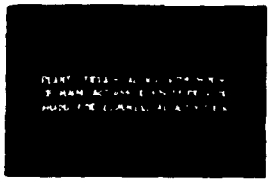
40. Such spaces turn into a stage during community functions, weddings or religious ceremonies.



41. To summarize,
- -- trees enrich the living environment,
- -- the cost of planting is low,
- -- they become important landmarks and reference points,
- -- the presence of trees encourages a wide range of private and community activities,

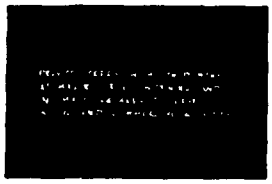
42. Since trees take a long time to grow they should be planted early in the construction process. This is a view of a sites and services project in Madras, before its completion--notice the trees along the main street.

43. By the time that the project is ready for occupation, the trees are large enough to serve a useful purpose.

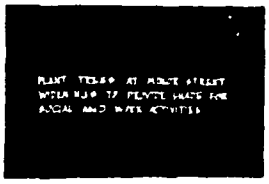


44. Trees should be considered as part of the basic infrastructure that is supplied by the housing authority in sites and services projects.

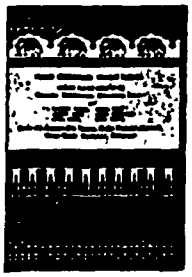
(Guideline) Plant trees along both sides of main access roads to provide shade for commercial activities.



45. (Guideline) Provide trees with low plinths at major street widenings and in small squares to serve social and commercial activities.



46. (Guideline) Plant trees at minor street widenings to provide shade for social and work activities.



47. This training package has been prepared with the support of the Canadian International Development Agency. For further information please contact the Vastu-Shilpa Foundation, Ahmedabad, or the Centre for Minimum Cost Housing, McGill University, Montreal.

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5. TREES AND PUBLIC SPACES - Questions and Topics for Discussion

1. List some of the different benefits from trees planted in streets to the urban population?

2. Do you know the different species of trees in your area that are commonly planted for shade? For fruit? For fuel?

3. What are the agencies involved in planting and maintaining trees in public spaces? Do these agencies show any preference for particular locations when planting trees?

4. Is it feasible to allow people to plant and maintain trees in public areas, adjacent to their homes? What are the advantages? What are the disadvantages?

5. Can you think of any ways that would encourage people to plant and maintain trees?

6. Do you know the current proportion of the budget in low-income housing projects that is spent on landscaping and tree planting? Is this sufficient to implement some of the suggested Design Guidelines?

7. In your experience, is tree planting given sufficient emphasis in low-cost housing projects. If the answer is no, then why not?

8. What are the benefits of planting trees along access roads?

9. What are the benefits of planting trees along small streets?

10. What are the benefits of planting trees in street widenings and small squares?

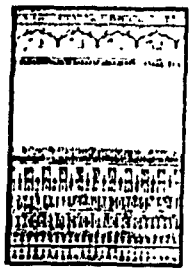
11. In the case of a restricted budget, in your opinion, which locations should be given priority for tree planting?

12. Do you think that all or some of the Design Guidelines which have been described in these Training Packages could be incorporated in future housing projects?

13. Is there something in this Training Package that you disagree with, or which doesn't accord with your experience?

House Extensions

6. HOUSE EXTENSIONS



1 This presentation is part of a comprehensive set of training materials prepared by a cooperative effort of the Vastu Shilpa Foundation, Ahmedabad, and the Centre for Minimum Cost Housing of McGill University, Montreal

2 This series of slides describes the various ways in which people extend their houses towards the street, and how they use these spaces

3 We call a house extension the space in front of the dwelling that is normally a part of the public realm, but which has acquired a private character through its use and physical modification. Thus, it represents an intermediate zone between the home and the street

4. Obviously, these spaces expand the area of what is usually a very small house, but in doing so they become integral parts of the living and working environment.

5 The porch is a classic architectural device found in almost all hot climates; it provides a shaded space, protected from the rain, and functions as an outdoor room.

6. In a village house the porch usually faces the street and acquires a half private, half public, character This example is from Madhya Pradesh.

7. Balconies and platforms have always been a common feature of traditional neighborhoods in Indian cities. This street is in a town in Rajasthan.

8. Even in very poor urban settlements, rudimentary house extensions allow every individual--young or old, male or female--to participate in public life.

9. It is unfortunate that many planned housing developments seem to have ignored the importance of traditional porches and platforms.

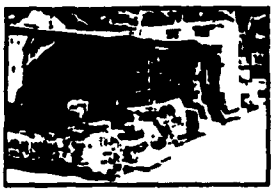
10. In many cases, building regulations discourage the building of house extensions, and the street becomes simply a corridor for movement.

11. What a difference when domestic life spills into the street!

12. Platforms and stoops are such an important and integral part of Indian life that even when they are not provided by designers, as in this planned development, they soon begin to make their appearance.

13. Notice how the platform has been built into the corner of this building, and how many activities are going on there.

14. Houses can be extended in many ways. The stoop is the smallest and simplest of these.



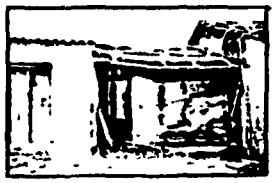
15. Porches and outdoor rooms are larger and more elaborate types of extensions.

16. Furniture placed in front of the home defines a temporary use of the public space.

17. Low brick walls signal a permanent extension.

18. People do not build porches and platforms simply to enlarge their homes; they are a place for a wide range of public and private activities. Domestic chores, such as washing, can be conveniently performed on a stoop which is next to the front door.

19. The area in front of the house can be also used as a place for sleeping, both during the day and at night, especially during the summer.



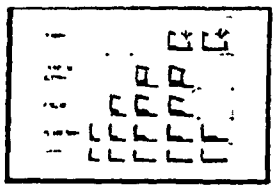
20. The space immediately outside the house is secure and protected, and so is often used for storage for a wide range of household goods. Here earth building materials are being kept for future use.

21. A large stoop or paved terrace also provides a convenient place for cottage industry.

22. If the house is located on a busy street the space in front of it can be turned into a shop. This coconut seller needs only a narrow stoop to display her wares.

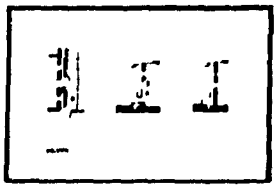
23. Tulsi pots and small religious shrines can be accommodated in a porch without any difficulty.

24. A porch offers shade and security for domestic animals, as well as for people.



25. House extensions are classified in five categories:

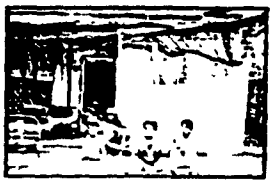
- stoops,
- platforms,
- porches,
- outdoor rooms, and
- yards. Let us examine them one by one.



26. (Stoops) The simplest, smallest, and cheapest extension is the stoop.

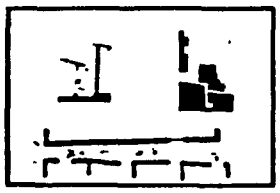
27. Stoops can be made of a variety of materials; this one is simply beaten earth plastered with cow-dung.

28. A better quality stoop is built out of stone.

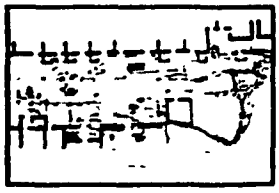


29. Just by a small change of level, the stoop is separated from the street and becomes a more useful space. The level change also makes a good seat.

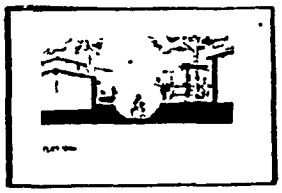
30. The stoop can accommodate commercial activities, like this workplace...



31. The size of the stoop is usually constrained by the width of the street, and the smallest stoops tend to occur in narrow lanes.



32. When a street is wider, the stoop is enlarged to leave just the minimum circulation area in the middle.

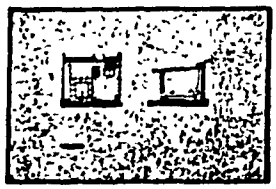


33. (Platforms) The stoop is defined by use, by a change of material, or by a minimal change of level, no more than a step. When this change of level is greater, we refer to the stoop as a platform.

34. The larger change of level clearly marks the private area. Unlike stoops, platforms always represent a permanent use of the space, although they are still inexpensive to build.

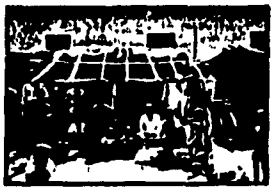
35. Platforms clearly define private areas that encourage more personal activities such as washing.

36. Like stoops, platforms can be gathering spaces where family and neighbors meet together.



37. (Porches) When a stoop or platform acquires a roof, it can be referred to as a porch.

38. Often 2 or more poles are erected on the platform to support a temporary roof, or a clothes-line for drying laundry.

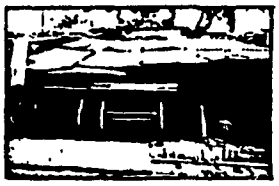


39. Porch roofs are usually supported on a framework of cheap wood.

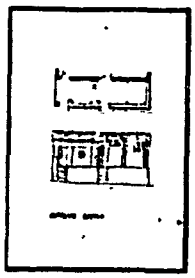
40. Inexpensive materials such as thatch, plastic or canvas are used on top of this framework as roofing.

41. Sometimes more permanent materials such as clay tiles or tin sheets replace the temporary ones.

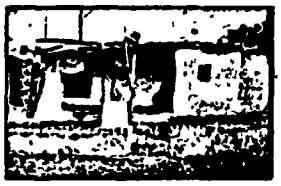
42. Porch roofs provide much-needed shade and exposure to cooling breezes. They serve the same purposes as platforms for living and working activities.



43. As well as bicycles and mopeds, larger vehicles such as push-carts can be accommodated under the porch roof.



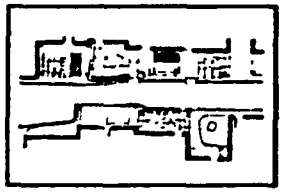
44. (Outdoor rooms) A porch that is enclosed becomes an outdoor room.



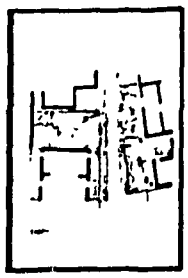
45. This roofed platform achieves a greater measure of privacy and security through the use of a wall on one side.

46. Screens can be erected to give complete privacy, but still provide cooling ventilation and view to the exterior.

47. Outdoor rooms can accommodate some quite personal activities, such as bathing.



48. Outdoor rooms are usually quite wide, and vary in depth from 1 1/2m to 2 1/2 meters, and sometimes stretch across the entire width of the dwelling. This slide shows a group of extensions on a street.



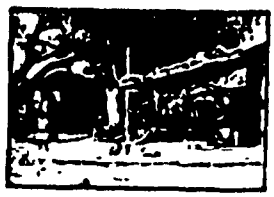
49. (Yards) Yards are the largest form of house extension. Because of their size they are less common in dense slums.

50. When they do occur, yards are usually fenced around for security and privacy.

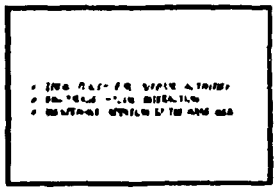
51. Because of their large size they can be used for gardening...

52. ...or for parking large vehicles, such as autorickshaws.

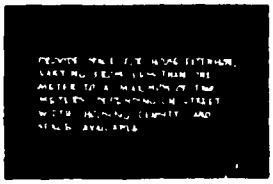
53. All these different house extensions provide an important benefit to the individual, but they also affect the public space. Streets without porches, platforms and stoops become dead places.



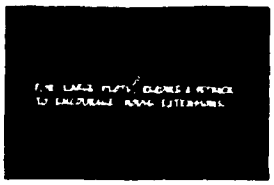
54. On the other hand, even a slum street can become a human, lively environment when it is affected by the presence of many and varied house extensions.



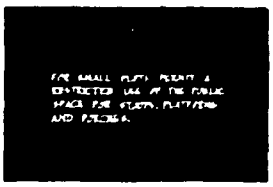
55 To summarize, the main advantages of house extensions are:
- they are ideal places for many outdoor domestic activities,
- they encourage social interaction between the family and the street, and
- they provide an inexpensive addition to the house area.



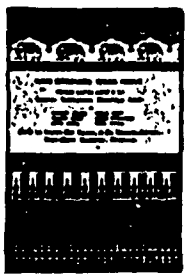
56. Planning regulations should be modified to recognize the importance of house extensions, and to encourage the development of a semi-public intermediate zone in front of the house. (Guideline) Provide space for house extension, varying from less than one meter to a maximum of two meters, depending on street width, housing density and space available.



57. (Guideline) For large plots, require a setback to encourage house extensions.



58. (Guideline) For small plots, permit a restricted use of the public space for stoops, platforms and porches.



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6. HOUSE EXTENSIONS - Questions and Topics for Discussion

1. Can you list some of the house extensions that were described in the Training Package, or that you have seen elsewhere?

2. Can you list some of the activities that take place on house extensions?

3. Why do people in low-income neighborhoods build house extensions?

4. Do you think, after seeing this Training Package, that house extensions are a useful ingredient of housing?

5. Do current planning practices encourage or discourage owner-built house extensions?

6. Have you seen examples of house extensions in planned housing projects? What kind? If not, why do you think that they were absent?

7. Do you think that it is feasible to permit some form of private house extension on public land?

8. How could a building regulation be written to permit house extensions, and also to safeguard street traffic?

9. What is more important in determining the dimensions and character of house extensions: plot size, street width, housing density, plot location?

10. Is it possible to consider house extensions for extremely small plots?

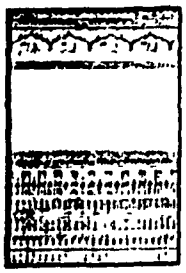
11. Can you think of different house extensions that could be considered for different budgets?

12. Do you think that all or some of the Design Guidelines which have been described in these Training Packages could be incorporated in future housing projects?

13. Is there something in this Training Package that you disagree with, or which doesn't accord with your experience?

Neighbourhood Streets

2 NEIGHBOURHOOD STREETS



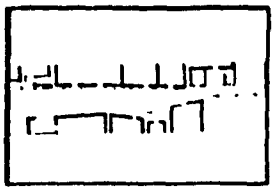
1. This presentation is part of a comprehensive set of training materials prepared by a cooperative effort of the Vastu-Shilpa Foundation, Ahmedabad, and the Centre for Minimum Cost Housing of McGill University, Montreal.

2. This series of slides describes the character, size and design of neighborhood streets and open spaces in low-income urban settlements.

3. Streets are used not only for circulation and access--but also as places for social and cultural interaction. In addition, many household, commercial and work activities are performed here.

4. Enhanced by the presence of elements like platforms, trees and shrines, neighborhood streets are important community spaces.

5. Although neighborhood streets are narrow, the slowness of traffic allows pedestrian and other movement to coexist.

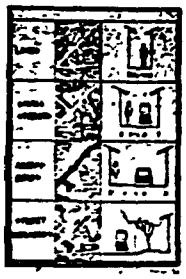


6. Streets with varying widths, and with twists and turns, provide useful spaces for passerby to stop, for housework, and for sidewalk vendors and other small businesses.

7. Unfortunately, most modern housing projects disregard the special character of neighborhood streets. Streets are designed strictly for circulation, and use standards that often disregard the type and frequency of traffic that actually exist in low-income settlements.

8. When open spaces are provided, they are divorced from the streets and get little, real use.

9. Slums and unplanned settlements are characterized by lanes and small streets, which are appropriate to the lifestyle and traffic patterns of the urban poor.



10. It is important to understand the characteristics of neighborhood streets and open spaces. They can be classified according to scale, use pattern and the nature of traffic, into four categories: 1.Lanes, 2.Small Streets, 3.Access Roads, and 4.Streets Widenings.
A combination of all four is required to make a successful plan. Let us look at each in detail:

11. <u>Lanes</u> - Lanes are the narrowest circulation links, connecting small streets. They are usually between 1 1/2 to 3 meters wide.

12. Lanes are useful because they often give access to only a small number of houses and therefore have a more private and individual character. Consequently, they can be used for relatively private domestic activities. In this case the house extensions in front of each dwelling form a band of seats of varying heights. Notice that the width of the lane permits people sitting on either side to converse.

13. Traffic on narrow lanes is restricted to pedestrians, although there is room for the occasional bicycle.

14. Due to the more private nature of these lanes, they are used for such household activities as cooking and washing.

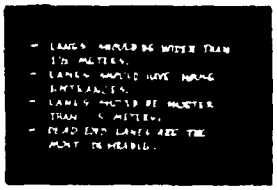
15. Private lanes can be used for various festivities. Here the lane has been decorated for a marriage ceremony.

16. Less exposure to passersby make lanes more secluded than streets. This dead-end lane has been paved and maintained by the individual families, and has become a useful space.

17. It is better to avoid lanes on which houses do not front since they lose their domestic character and end up being used as storage or parking spaces.

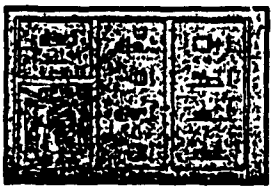
18. Extremely long, narrow lanes will not function successfully, and end up as dumps for refuse and garbage.

19. (Guidelines)



-- lanes should be wider than 1 1/2 meters,
-- lanes should have house entrances,
-- lanes should be shorter than 15 meters,
-- dead-end lanes are the most desirable.

20. Small streets - Small streets are defined as being 3-5 meters wide, and giving access to individual houses. They should form the majority of the neighborhood circulation.



21. The traffic on small streets consists of pedestrians and a large variety of slow-moving vehicles.

22. The most commonly used vehicles in low-income neighborhoods are bicycles. Due to their small size, they can easily pass without disturbing the other activities taking place on the street.

23. Pushcarts are commonly used for transporting and selling goods. They are approximately 1 meter wide and therefore do not require a wide street.

24. Other vehicles that can circulate on small streets include auto-rickshaws and pedal rickshaws, which are 1-2 meters wide. Even cars can pass through this small street if required.

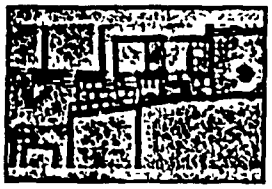
25. Apart from the obvious function of circulation and access, the small streets in low-income neighborhoods accommodate a variety of household, economic and social activities.

26. Many commercial activities, like this small shop, can also be accommodated on small streets.

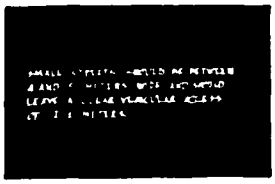
27. The presence of house extensions provides spatial variety and a setting for different activities.

28. Trees are important features that improve the environment of the street.

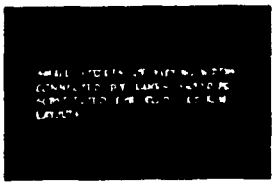
29. The distinctive character of the neighborhood street is further enhanced by the presence of special features such as gates and small religious shrines.



30. The physical configuration of the small street can influence the type of activities that take place there. A street with varying widths and trees is suited for many social and commercial uses.



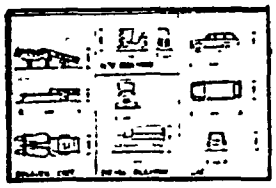
31. (Guideline) Small streets should be between 4 and 5 meters wide, and should leave a clear vehicular access of 2 1/2 meters.



32. (Guideline) Small streets of varying widths, connected by lanes, should be substituted for rigid, gridiron layouts.

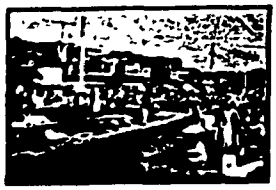
33. Access roads - Access roads are 5-9 meters wide and connect the settlement to the city street network.

34. Access roads are major thoroughfares with a continuous flow of pedestrian and vehicular traffic; they are the main activity spines of the community.



35. Besides bicycles, auto-rickshaws and pushcarts, larger vehicles such as bullock carts, tempos, cars and taxis use access roads.

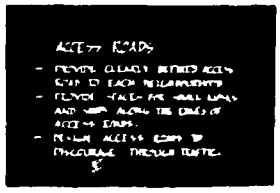
36. Slow-moving trucks and vans can also go through.



37. Access roads are ideal for commercial activities. They become local bazaars with hawkers, and temporary as well as permanent shops.

38. Public structures such as large temples are commonly located along access roads, and become gatherings places for the whole community.

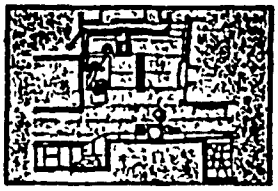
39. Despite their heavy vehicular traffic, access roads are not simply automobile carriers. Vehicles of all sorts have to co-exist with the pedestrian flow, as well as with the various activities which take place at the edges of such roads.



40. (Guidelines)

-- provide a clearly defined access road to each neighborhood,
-- provide space for small kiosks and shops along the edges of access roads, and
-- design access roads to discourage through traffic.

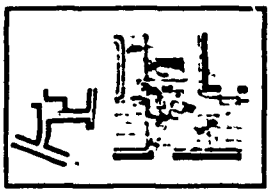
41. <u>Street widenings</u> - Street widenings are small, open spaces that are an expansion of the street space. Street widenings include enlarged intersections and small squares.



42. Street widenings can be of different widths. A small 2-3 meter side space can comfortably accommodate domestic activities. When this widening is increased to 3-5 meters, it can be used for community and commercial activities as well as domestic ones.

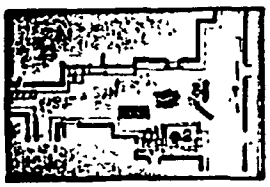
43. Shade trees can be planted in street widenings to make spaces for working and resting. These pockets remain undisturbed by the traffic, even though they are a part of the public street.

44. In large widenings, in addition to a tree, a low platform can be accommodated. Such places are ideal for social gatherings and group activities.

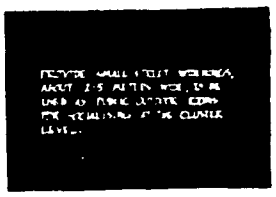


45. The widening of an intersection can create useful, small spaces.

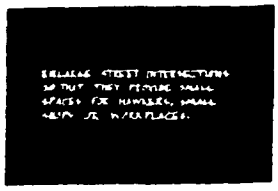
46. Apart from being community gathering spaces, street widenings, especially at intersections, have a more commercial character because of greater exposure to passersby. A small vegetable stand or a tea shop can be located there.



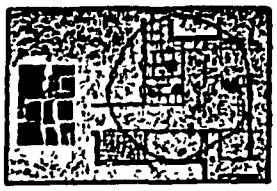
47. Street widenings can be used as spaces for setting up temporary workplaces; here this carpenter is working in a street intersection.



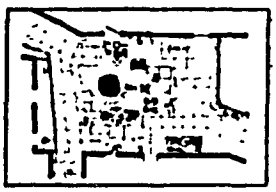
48. (Guideline) Provide small street widenings, about 2-5 meters wide, to be used as public outdoor rooms for socializing at the cluster level.



49. (Guideline) Enlarge street intersections so that they provide small spaces for hawkers, small shops or workplaces.



50. A larger, more defined street widening produces a small square. Small squares can accommodate public gatherings, festivities, work activities and a number of other social and cultural functions related to the lifestyle of the people living there.

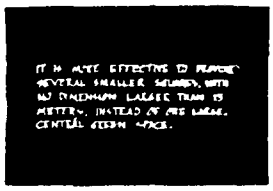


51. Small squares are defined by the houses that border them, creating a sense of enclosure. These households often use the perimeter of the square for domestic activities, leaving the central portion for public use.

52. Small squares with centrally located trees and platforms can become neighborhood community centres for larger gatherings.

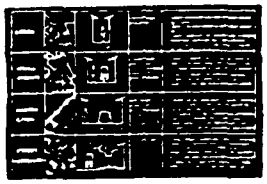
53. It is not sufficient to simply set aside land for community use. If open space is divorced from street life it will not be used effectively.

54. Spaces that are too large are impersonal and uncomfortable. If they are not used--or used by very few--they represent a waste of valuable land.

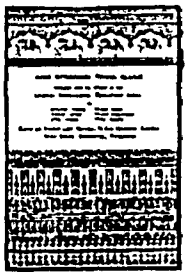


55. (Guideline) It is more effective to provide several smaller squares, with no dimension larger than 15 meters, instead of one large, central green space.

56. The function of streets in low-income neighborhoods should not be restricted to circulation and access. These are places for socializing, performing household activities, work and commerce.



57. It is important to understand the use and physical characteristics of neighborhood public spaces which are summarized here. The presence of all four features--lanes, small streets, access roads and street widenings--is essential to the development of a successful neighborhood plan.



58. This training package has been prepared with the support of the Canadian International Development Agency. For further information please contact the Vastu-Shilpa Foundation, Ahmedabad, or the Centre for Minimum Cost Housing, McGill University, Montreal.

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2. NEIGHBORHOOD STREETS - Questions and Topics for Discussion

1. Do you agree that streets in low-income housing projects should support a number of activities other than access and circulation?

2. What are the advantages of allowing household, social and commercial activities to coexist with vehicular and pedestrian traffic?

3. What are the disadvantages?

4. Should there be a hierarchy of different street widths, or should there simply be one standard width?

5. What are the benefits of narrow lanes?

6. Do you think current planning regulations governing street widths are too large? Or too small?

7. What are the advantages and disadvantages of smaller plots and larger streets vs. larger plots and smaller streets?

8. Do you agree that many small public spaces are more useful than one large, single green space? In your experience, are such spaces used effectively?

9. Do you think that the grid layout for streets is the only efficient solution? Can you think of ways in which street widenings and irregular spaces could be incorporated into housing layouts?

10. Street activities such as sidewalk vendors, household and commercial work, and social and religious events can easily obstruct pedestrian and vehicular traffic. What can the designer do to minimize this problem?

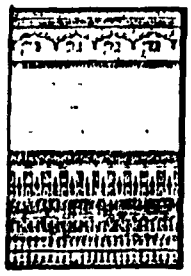
11. Besides trees, platforms and religious shrines, what other public structures are common in public squares?

12. Do you think that all or some of the Design Guidelines which have been described in these Training Packages could be incorporated in future housing projects?

13. Is there something in this Training Package that you disagree with, or which doesn't accord with your experience?

Work Places

3. WORK PLACES



1 This presentation is part of a comprehensive set of training materials prepared by a cooperative effort of the Vastu Shilpa Foundation, Ahmedabad, and the Centre for Minimum Cost Housing of McGill University, Montreal

2 Just as the urban poor take into their own hands the provision of inexpensive shelter, they also initiate a wide variety of commercial activities. This series of slides describes how work places are combined with the living environment.

3 Work activities are an integral part of housing in traditional neighborhoods. This slide shows the warp for making sarees being set up in a street in Benares

4 The finished warp is moved into the house for the actual weaving. Notice that both the space next to the dwelling, as well as the house itself, are used as a work place

5 In a modern city, employment usually implies industry. However, large technology require large capital investments, as well as land and resources, which may not be available in close proximity to low income neighborhoods

6 One alternative is to provide relatively small workshops which can be leased or sold to entrepreneurs who will employ workers locally. This innovation was recently tried in a Madras Urban Development Project

7. There is a third alternative: even smaller workshops that do not require investments from outside the community, and can take advantage of existing entrepreneurship and commercial know-how.

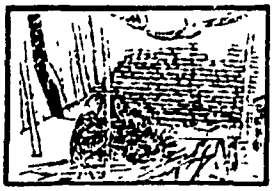
8. Many small-scale commercial activities can be set up with very little investment. Such work places can take many forms. The first category is oriented towards providing services to the immediate neighborhood, like this man weaving a chair. Let us look at a few more examples of such activities.

9. Manual laborers, such as bricklayers and carpenters, can be hired locally as temporary help. The carpenter sets up his workshop in the street. Here he is making doors and windows from old frames and other scrap wood

10. Due to constant use, chairs and beds frequently require reweaving The craftsmen who provide this service move from house to house

11. This roadside tailor does small repairs and alterations for neighborhood clients.

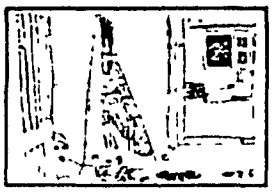
12. A tinsmith is making containers out of old kerosene cans collected by his clients. These metal boxes will be used as storage bins for grain and other dry food.



13. Another common type of work involves producing items for the larger urban market. Raw materials are usually purchased in the city and reprocessed into sellable items, such as the baskets being woven here.

14. Brooms are produced out of dried palm leaves. They can be fabricated by one person and require a minimal area for work and storage.

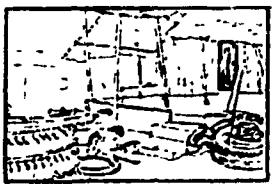
15. Waste materials such as cloth or wool are made into harnesses for animals. This is a household activity, carried out by women, mostly in afternoons after they have completed cooking and cleaning.



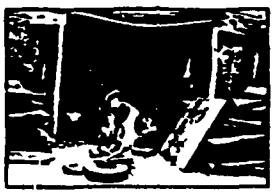
16. All members of the family are involved in making wooden combs. Wood is split into thin slivers with an axe, and then shaped, using hand-tools. Finally, the teeth are cut with a fine hand saw.

17. Bamboo screens are used during the summer to provide protection from the sun. Slats of bamboo, or reeds, are woven together with string.

18. The lowest type of work, done by the poorest people, is the sorting of garbage. Glass, paper, and metal are collected from different parts of the city, and separated at home before they are sold to the scrap dealer.



19. Old automobile tyres, generally bought from scrap merchants, are converted into sandals. This activity usually involves two or three persons. The lighter work is done by women while the more arduous work of stripping tyres is done by men.



20. Metal workshops make drums, containers and other kitchen and household implements that will be sold in the local market.

21. Cottage industries are common in low-income areas. Raw materials are provided by entrepreneurs, who later purchase the finished product from the workers. These men are making jewelry.

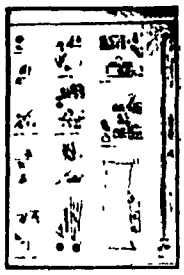
22. School-dresses and other uniforms are made here, and marketed through retailers. Wholesalers supply pre-cut pieces and collect the finished garment.

23. Beedi making involves at least two persons, working in an assembly like fashion. The raw materials, which include special dry leaves, tobacco and thread for wrapping, are generally given out on a consignment basis by a local distributor.

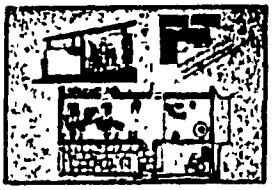
24. Some things are made only for special occasions, or during a particular season of the year. Here a craftsman is making religious statues for the forthcoming Ganesh puja

25. Both children and adults fabricate bracelets of silk or cotton thread for the Hindu festival of Rakshabandhan.

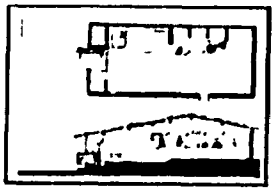
26. Noodles are made by a group of women, working outside the house.



27. Different kinds of work need different sizes and shapes of space. As can be seen at the top left hand corner, the activity of bracelet making, needs a very small area. On the other hand, braiding rope, shown on the right, requires the length of the street. Some work occurs mainly in the house extension, or in close proximity to the home, and some spills out into the public spaces and streets.

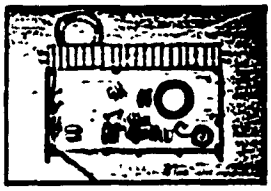


28. In this illustration, a small workshop that polishes aluminum utensils is established inside the house. Four persons work here. The two storage spaces behind the work area are for unfinished items, and for polished goods.



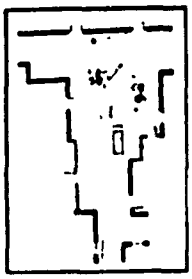
29. This workshop produces canvas awnings, and needs a large floor area 3 meters wide by 8 meters long. This work activity is confined to the interior for reasons of security.

30. Making wooden crates involves recycling old boxes that are repaired, and resold in the local market. This activity requires a lot of space for storing the materials and the bulky crates. The repair work is mostly carried out in the house extension and the ready crates are stored outside

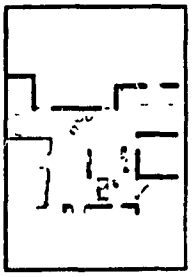


31. Sandals are being made out of stripped automobile tyres. This work is confined to the house extension and the ready sandals are stored inside the home.

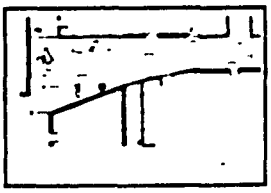
32. Papad is thin rolled bread that is sun dried and is made during the summer by groups of women. The work is done mainly outside the house, or in the house extension, where the finished bread can be dried on beds.



33. Sometimes work is done in public spaces Here a carpenter has set up his working place in a street widening.

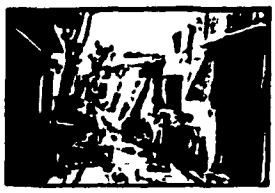


34. This little square surrounded by a group of houses is an attractive work place. People are making string out of waste cotton.



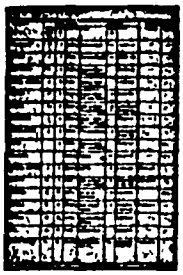
35. This person is repairing metal trunks in the road intersection. The shade provided by the tree also attracts other household activities.

36. Rope making requires long open spaces. The verges of roads are suitable for this work, especially if trees provide the comfort of shade. The finished ropes can easily be stored in a basket inside the house



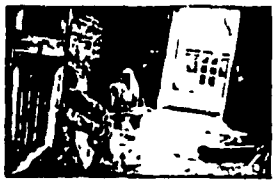
37. Even narrow lanes can be work places. The side of a house supports a signboard while it is being painted.

38. In this illustration, a public open space in a resettlement colony has been turned into an improvised kiln and storage area for the fabrication of clay pots.

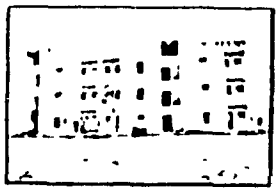


39. There is a wide variety of spatial requirements in terms of area, shape and character of space for different types of work activities.

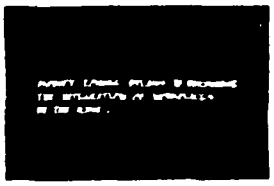
40. Many work activities do not need large formal areas and can take place within the house extension, and in other semi-public areas; they can also co-exist with other domestic activities.



41. Integrating work and living areas provides the economic and social benefits of increased family income using modest, existing resources.

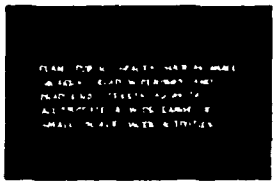


42. Unfortunately modern housing usually ignores the importance of providing small work areas and misses an important opportunity to encourage people to help themselves.

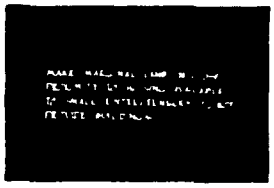


43. Planners and architects should be sensitive to the economic and social advantages of small work places.

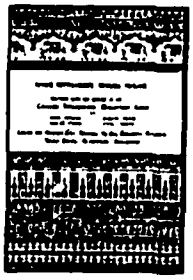
(Guideline) Modify zoning bylaws to encourage the integration of workplaces in the home.



44. (Guideline) Plan public spaces such as small squares, road widenings, and dead end streets, so as to accommodate a wide range of small-scale work activities.



45. (Guideline) Make marginal land, in close proximity to housing, available to small entrepreneurs. Do not provide buildings.



46. This training package has been prepared with the support of the Canadian International Development Agency. For further information please contact the Vastu Shilpa Foundation, Ahmedabad, or the Centre for Minimum Cost Housing, McGill University, Montreal.

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3. WORKPLACES - Questions and Topics for Discussion

1. What different kinds of work activities have you seen yourself in low-income neighborhoods?

2. Are the work activities in slums and squatter settlements different from those observed in planned housing schemes? Is this because a) people in planned projects tend to be financially better off, or b) there is no space for such work?

3. Have you seen or visited a planned, urban housing scheme where workplaces have been integrated with housing? If yes, how was this done?

4. Do the current planning practices make any special effort to integrate workplaces with housing. If yes, how?

5. If no, then, in your opinion, why not?

6. What are the social and economic advantages of integrating working and living space?

7. What are the disadvantages of integrating working and living space?

8. What modifications could be made to bylaws and building regulations that would encourage the provision of small, informal workplaces?

9. Is there a need, in your experience, for more permanent types of workplaces such as small workshops?

10. Do some of them require storage space, water supply, or electricity?

11. Instead of providing workspaces in public areas, would it be more useful to provide slightly larger plots?

12. Do you think that all or some of the Design Guidelines which have been described in these Training Packages could be incorporated in future housing projects?

13. Is there something in this Training Package that you disagree with, or which doesn't accord with your experience?