S U B U R B A N R E S I D E N T I A L S T R E E T S C A P E :
AN INVESTIGATION OF DEVELOPMENT CONTROLS AND PRACTICES

by

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A B S T R A C T

The recent explosive growth of suburbs may be interpreted to be a contemporary expression of man's basic desire to secure for himself an improved living environment. This modern exodus of population to suburbs in North America was made possible by the automobile, which, by making individual mobility a reality, enabled man to establish his place of residence away from his place of employment in accordance with his desires and needs. The automobile, therefore, can be said to be largely responsible for the growth of the suburbs which surround to-day's North American towns.

But the advantages introduced by the automobile are also accompanied by numerous adversities which are just beginning to emerge. Large portions of our cities are devoted to intermittently occupied blacktop parking lots and our suburbs consist of intricate networks of monotonous streets along which men have established their residences which were to be their private, secluded havens.

The objective of this study is to investigate the effects of current street right-of-way and other develop-

ment regulations and practices on the emerging suburban residential environment and streetscape design, and to gather and to present recommendations for the enhancement of conditions.

To this end an analysis of the needs of man the resident, man the pedestrian, and man the driver in a study unit was undertaken through an examination of the literature. It was observed that the presence of the automobile in our society has created numerous problems and that attempts are being made to resolve the dilemmas. But it was also observed that most past and current remedial attempts emphasize further provision for the car and this usually at the expense of the resident and the pedestrian. For the purpose of this study it was concluded and shown that the present study unit environment, or streetscape, in a suburban residential development is adversely affected by the automobile.

Next, the focus of the study was shifted to an analysis of common suburban streetscape development regulations and practices. It was observed that most regulations and methods, although being fair attempts to deal with a complex problem, are antiquated and ill-suited and do not satisfy to-day's requirements.

Next, with the support of the observations and conclusions from the preceding analyses and additional investigation of alternate and more contemporary development concepts, through an examination of the planning literature, recommendations were presented for the enhancement of

study unit environment and streetscape development. It was concluded, that by the implementation of hierarchical circulation channels, by revision of uniform zoning controls and inflexible subdivision regulations, and by adoption of comprehensive study unit development plans, both the streetscape and environmental quality of existing and future suburban study units could be improved in an economic manner.

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INTRODUCTION

Generally speaking, the North American town inherited at its incorporation a street pattern which was clearly fashioned along the lines of surveying practices employed both by the absentee "subdividers" in Europe and the pioneer settlers crossing the continent, namely, that of the rectalinear gridiron.[1] In the days of great land booms and speculative activity of a generation or so ago, this subdivision technique appeared to offer numerous important advantages, both to the vendor and the purchaser. It was particularly well suited for almost unlimited re-subdivision and/or extension and required only the most rudimentary form of surveying and recording for the purpose of identification. In those days the townsites were quickly lotted and marketed and, as a general rule, without much thought having been given to the emerging townscape, to the inter-relation of its functional components and staging of development, or to the prevailing physical features and natural barriers of a given townsite.

Consequently, the first major task facing the early civic bodies was to put some order into the development of the area under their jurisdiction by setting up certain basic development and servicing regulations and requirements, which would make private investment more secure and ensure the citizens at least a minimum of health standards, safety, fire protection, light and air, and so forth.[2] Most of these early regulations, usually set forth in by-laws, have been gradually amended over the years since incorporation, but many of the basic development policies and standards have remained relatively unaltered and their alleged benefits unchallenged. In fact, some of the most arbitrary regulations have been accepted as 'norms' despite technological proof and know-how to the contrary. One such unquestioned regulation deals with public road allowances or streets: their purpose, their usage, and their development.

Streets are an essential part of any human community, and due to the requirement that all parcels of land abut on a public road allowance, the common width of which has been accepted to be one chain,[3] they are also a major land use and normally only second in total areal extent to the primary use which they serve. It is not unusual that in a typical North American 'grid town' anywhere from one-fifth to one-half of the town's total land area is dedicated as public street right-of-way, with 33 per cent being the approximate norm. The total effective width of streetscape[4] from building line to building line, however, could in most

instances double the above mentioned percentages and, consequently, it would be quite fair to say that streets are THE major land use even if they exist only to serve the primary land use. Their dominance becomes particularly evident in single-family residential areas where population densities are low and where housing bordering the street lacks the necessary height and variety to overcome, or to compete with, the spaciousness of the right-of-way, i.e. to complement, or to permit integration of design of the street right-of-way with the design of blocks, lots and dwellings.

Originally the streets were intended for the use of pedestrians and by today's standards relatively slowly moving horse-drawn carriages, but with increasing population densities and a variety of technological advancements they have been subjected to numerous other uses as well.[5] The introduction of new uses to the existing street has been a gradual process which is still continuing in a piecemeal fashion, hampered both by the local economic situations and the difficulty of changing established practices and customs. As a result, and particularly because of the faster mode of travel introduced by the automobile, the streets are no longer as safe and pleasant as they used to be. But, besides providing access, carrying utility lines and permitting various modes of circulation, streets also have other functions to perform: they ensure air and light to building fronts, open up vistas, and provide a neutral ground where people can meet, etc., but above all they form a setting for

development along it. Consequently, they greatly affect the market values of abutting properties and improvements and also help to determine, to a large extent, the visual character and image of a street, a neighbourhood, or a whole community. It follows then, that the quality of a streetscape plays a vital role in creating an environment which is both attractive and safe to live in as well as economical from the servicing and development points of view.

While zoning, subdivision, and other municipal by-laws of varying degrees of complexity regulate the use and development of land and improvements along a street, the streetscape itself has remained relatively uncontrolled and unplanned. Roadways, utility lines and other items of street furniture are customarily being designed and installed not as integrated components of the streetscape, but as independent or isolated units and often with unhappy consequences to the total streetscape and the residential environment. This is strikingly true of the miles and miles of residential access streets and areas which are only partially developed and serviced to-date and where one service or item is being added at a time. In the more recent subdivisions, and particularly in the larger, planned unit developments, roadways and utility lines are being planned and constructed more or less as complete units mainly because most of the necessary services are being

installed simultaneously, but the comprehensive design of streetscape is yet to be accepted as an integral part of the total municipal engineering or public works process.

The objective of this thesis is to investigate the effects of current street right-of-way and other development regulations and practices on the emerging residential environment and streetscape design, in what, for the purposes of this study, may be called a typical North American setting. The primary examples of current practices are drawn from the Lower Mainland Region of British Columbia.

The specific purpose of this study is two-fold. First, an investigation of the needs and desires of man — both as a resident and as a driver — as the primary user of the street and the number one beneficiary of the environment, culminating in an analysis of current street development regulations in order to determine their compatibility. And second, a presentation of basic recommendations for the enhancement of environmental conditions and for functional development of suburban single-family access streets.

It is difficult, and perhaps even impossible to determine precisely what the public really expects from their environment, and to what degree their desires and requirements are being met by existing development policies and standards; what they actually want, and what they are willing or able to pay for are not necessarily one and the same. Therefore, for the purpose of this study, it is assumed

that it is the universal desire of man to seek and to demand, within his own financial capability, an environment which will offer a safer, more pleasant, more economical as well as a more functional setting for his investments. It is also assumed that it is the desire and responsibility of every elected and appointed civic official to attempt to improve the living environment in his community in the most economical manner available to the community.

Furthermore, it is advanced that for the purpose of this investigation, the basic study unit is taken to be a road allowance, which provides access to abutting single-family dwellings and that this unit and the development bordering it are controlled by a set of common land use development regulations. The length of such a unit is, and should be, variable and must be related to physical and functional characteristics of its roadway and right-of-way. For example, a cul-de-sac is a natural study unit and so is a loop street, but a longer connecting street may well be broken into a number of units, especially if its vertical and horizontal alignments change due to topographic or other circumstances. In other words, a study unit is a logical and rational unit or level of thinking and action. The unit environment, i.e. streetscape, is considered to be a result of both the development controls and the requirements placed on the study unit by all dwelling units[6] in its encatchment area[7] as well as of the function of the study unit's

roadway within the hierarchy of the neighbourhood and the municipal circulation system. Also, the unit environment is assumed to extend across the legal lines of the street right-of-way into the front yards of the lots and conversely, the dwelling unit environment, i.e. the private environment, is assumed also to extend into the road allowance. The resolution of this overlapping of public and private environments and interests is considered to be the key to streetscape design and street use planning, and consequently is the focal point of this study. It is not within the scope of this study, however, to explore the economic advantages to be gained from and the costs involved in the employment of new servicing methods, but certain new innovations, e.g. underground wiring, which are of unquestionable value in improving the appearance of a street, have been accepted as standards in the formulation of recommendations.

In Chapter One of this thesis an attempt has been made to establish through an examination of the literature the problems evolving from urbanization and the presence of the automobile in a suburban residential environment. Chapter Two contains an investigation and an analysis of current development regulations and practices pertinent to the development of a study unit. Chapter Three is devoted largely to a presentation of recommendations which were found to hold the greatest promise for the enhancement of conditions in a study unit. The last Chapter of this thesis, Chapter Four, offers a review of the study and contains an

appraisal of assumptions and an evaluation of the hypothesis.

Although the subjects of streetscape design and residential environment appear to lend themselves well to intensive and explicit investigation, it is by no means a narrow topic as it quickly involves many other fields, such as man's appreciation of aesthetic values, his tolerance levels of smell, noise and other adversities, his desire for privacy, as well as the less subjective fields of development economics, adequacy and validity of engineering standards, municipal law and administration.

The approach to the subject through literature was found to be most useful in the establishment of the basic principles for optimum environmental conditions in a study unit and techniques for achieving these. The general methodology, therefore, was to determine the characteristics of those aspects of study unit development which were anticipated to have both a direct and indirect bearing on the emerging quality of its environment, and to utilize these as a basis for the selection of recommendations for the improvement of the environmental quality of study units.

To this end the study contains two distinct analyses: first, an analysis to determine the requirements of an optimum residential environment; and second, an analysis of typical development controls and practices to determine their effectiveness in providing for such an optimum environment. With this in mind, the hypothesis established

for this study is stated as follows:

> that existing street design standards and development regulations adversely affect residential environment; and that, to achieve optimum residential environment, comprehensive street development plans must be an integral part of local government development policies.

FOOTNOTES

[1]The original and most common system of legal survey in Canada (and also in the United States of America) is the well known rectangular grid or township system (called District Lot system in parts of British Columbia) which covers the Nation in a continuous grid from East to West, except for Quebec where strip layouts abutting transportation routes (water and/or road) were employed (and parts of New England states where a system of metes and bounds was used).

[2]Christopher Tunnard and Boris Pushkarev, Man-made America: Chaos or Control? (New York and London: Yale University Press, 1963), pp. 86 - 97.

[3]1 chain = 66 feet; the full length of early surveying tape measure made up of 66 non-flexible links, each being one foot in length.

[4]See page 6 for the definition of this term for the purpose of this study.

[5]Carl B. Troedsson, The City, the Automobile, and Man (Sweden: Elanders, 1957), p. 5.

[6]Dwelling unit - a single-family house on a standard size lot accommodating one family.

[7]Encatchment area of the study unit - all dwelling units abutting the street.

CHAPTER ONE

MAN-AUTOMOBILE RELATIONSHIP

Urbanization, Man, and Automobile

Before embarking on a more detailed analysis of the man-automobile relationship a few introductory words about man and his fundamental objectives in life appear to be indispensable.

Basically, man is a creature of nature, and in his own biased opinion superior to all forms of life on this earth. He is said to possess a unique power which other creatures lack: the ability to reason; to weigh the pros and cons of a situation and thus to determine the most suitable course of action to be taken.[1] His actions, however, are motivated to a large extent by animalistic, selfish instincts: to seek and secure food, shelter, protection, etc., for himself and his next of kin. In so doing he has gradually extended his control over his immediate environment to an extent where he has more or less completely divorced himself from his original habitat,

i.e. from nature. But he is not infallible. For example, he has not succeeded in building for himself a paradise upon this earth and, in fact, many of his attempts have simply succumbed to the forces and laws of nature mainly due to his inability to comprehend these.[2,3]

John Ormsbee Simonds, a noted American landscape architect, says:

> Man . . . is a victim of his own planning. He is trapped, body and soul, in the artificial mechanistic environment he has created about himself.[4]

It is often voiced that one way out of this man-made chaos is to return to nature. But, a return to the primeval way of life could hardly be accepted to be man's ideal, for the story of man has always been a continuous struggle for the mastery of his environment. There has been, however, an increase in the awareness of the benefits to be gained from closer association with nature. The flight to suburbia from the cities may be interpreted as an indication of this awareness.

Suburbia is nothing new. It has always existed for the well-to-do but, the average urban man was barred from moving there simply because he lacked the means of transportation between his place of employment in town and the countryside. With the arrival of the automobile, however, the situation changed. Now the suburbs with their greenery and clean, unpolluted air were within the reach of the automobile owner, and this resulted in a mass exodus from

the city. This phase of urban development proved that once again man had failed to create a healthy and prosperous living environment for himself and that he, like his forefathers, is liable to abandon the old and replace it with a new, and hopefully, a better one.[5]

It is generally accepted that by giving people an unlimited freedom of mobility the automobile has unquestionably emerged as one of the most important single influences which has shaped and directed the growth of cities in the present century, and particularly so in North America. Obviously, it is all too soon to draw any concrete conclusions as to the value of the automobile to man; it could even prove to be impossible to arrive at a simple, clear-cut assessment of its value because of the myriad of factors that must be taken into consideration in such an appraisal. Yet, it is quite clear that despite the automobile's great potential and its present, undebatable usefulness it is also very rapidly becoming a burden and a liability. Its presence, for instance, in continously increasing numbers in the urban and suburban scene has created new, hitherto unknown, complex problems which nullify many of the advantages it appeared to offer at first. And unless man is willing to and capable of protecting his habitat from the adversities associated with increased urban expansion it appears that he is about to fail again in his attempt to create a safe, healthy and functional living environment.

The members of The Steering group of Traffic in Towns, amongst a great number of others, have sounded a warning in their report. They say:

> We are nourishing at immense cost a monster . . . which can spoil our civilization. . . . And yet we love him dearly.[6]

To-day considerable efforts are being made and large sums of money spent in every urban centre to correct the current adverse trends; to find a solution which would free both the automobile and man from their present shackles and permit them to exist in a mutually beneficial relationship. This is an overwhelming and commendable task indeed, but it is also one which because of its magnitude tends to overshadow many other important problems. For example, so accustomed and concerned have we become with the problems occurring daily on our major traffic channels that comparable problems and other adverse circumstances on local access arteries, i.e. secondary and tertiary streets, appear unimportant, and therefore, remain both unnoticed and uncorrected. The degree of seriousness of this situation is, perhaps, debatable, but it is well to remember that most of to-day's congested downtown arteries, as well as those leading to and from it, were once quiet residential streets just like most suburban streets are, or should be, to-day. And it is alarming to think that many of the latter may eventually become as unsuitable for residential purposes as their downtown counterparts. This has already happened to many streets

in uptown areas as well as to some in the vicinities of suburban centres or cores.

This study, therefore, is an attempt to determine the reasons for the decline of environmental qualities of residential access streets and endeavors to investigate what could and should be done to secure the residential characteristics of an access street in suburbia. In short, it is the suburban residential streetscape - its purpose, its usage, and its environmental quality which is the prime target of this investigation.

Development Controls

In his attempt to guard his "artificial mechanistic environment"[7] against possible adverse effects from forces and laws of nature, i.e. really from his own actions, man has devised a set of laws of his own to regulate his way of life. For the purpose of administering these laws he has also created various levels of public bodies whose duty it is in a democratic society to enforce these in a just and equal manner for the benefit of all citizens. It might be appropriate to mention here briefly that in Canada the provinces draw their legislative authority from the British North America Act, and that they in turn delegate portions of this power to their municipalities through provincial statutes.

The title of all public road allowances in Canada is vested in the Crown[8], but the right of possession and also the authority to regulate their development and usage lies

with the provincial governments. There is no federal highway authority to plan highways, give advice on construction standards, and to correlate the provincial highway building activities. Indeed, within the provinces the responsibility for roads and their development is divided among cities and municipalities, with the provincial highway departments controlling and developing roads of major or inter-municipal importance only. Thus, in Canada, there is no official national road system, but it is quite obvious that a hierarchy of roads, reflecting the nation-wide circulation needs, actually does exist and that these needs largely dictate a given road's dimensions and technical qualities.

In British Columbia the municipal authority to control development of roads within their boundaries stems from the Municipal Act[9] which states in part:

> The Council may regulate . . . by by-law . . . the dimensions, locations, alignment, and gradient of highways . . .
> . . . . . .
> require that highways be cleared, drained, and surfaced to a prescribed standard, . . . [10]

The same act also gives a municipality the power to regulate the use of land and improvements abutting the street through zoning and subdivision by-laws, and it requires that these regulations be uniformly applied to all districts designated for the same use. The basic objective of these development regulations is to ensure the citizens a maximum of health standards and safety by promoting orderly and economic development of communities.

From the above it can be seen that the two senior levels of government do not interfere with local administration and have trusted the drafting and adoption of appropriate regulations for the development of both local streets and abutting properties to the third level of government. Consequently, it is up to each local municipality to adopt its own standards and controls.

Generally speaking, site development controls are not too popular with either the public or civic authorities. For the property owner and developer alike, they appear to contain more restrictive clauses than permissive ones and thus the benefits derived through their usage are less apparent, i.e. the regulations are commonly written in a negative or prohibitive tone and the positive aspects derived through these are seldom referred to. To civic authorities, whose task it is to enforce these regulations, they mean administrative problems; the more complex these regulations are the more difficult is their task. Consequently the majority of municipal development by-laws in use tend to employ standards which are relatively simple and readily applied and which satisfy the basic objectives referred to earlier.

> Experience with absolute and rigid space standards has been long in terms of time; experience with more flexible performance standards has been short. . .It is a relatively simple matter for a building inspector to measure a fixed distance set down as a set-back requirement. It is more complicated for him to administer a formula which weighs set-back requirements as one of several inter-related requirements in siting a given building on a certain lot.[11]

These standards, both those which regulate the development of public road allowances and those which control the placement and erection of improvements on the abutting properties, have given, through their simplicity, a monotonous and sterotyped appearance to the emerging living environment and, consequently, have themselves become the subject of considerable and steadily increasing criticism.

The Royal Architectural Institute of Canada has looked critically upon the tools of the present development control machinery, and they point to a great number of things which in their opinion have an adverse effect upon the residential environment. They say in part:

> . . . It is possible, and not uncommon, for a whole township to be reduced to little pieces of identical dimensions; on each plot only one sort and size of house can be built.
> . . . . . .
> . . . For instance it is commonly laid down that an access road allowance must be 66 feet, with all buildings set back another 25 or 30 feet from that road line. These provisions sterilize 1000 square feet of land that some family should be allowed to enjoy. They also separate opposite housefronts by something like ten times their height, thus making illegal the grouping of houses for best effect at lowest cost. There are many other examples of this unreason.[12]

Eldridge Lovelace and William Weismantel, in their article on density zoning, put it this way:

> . . . Many communities reveal, as far as the eye can see, an unending procession of little uniform houses, on little uniform lots, all set back equally from the street like well-drilled soldiers in a row, with no variation in roof line or height. The whole depressing aspect is enhanced by the fact that trees, if any, are ridiculous, spindly replacements of majectic predecessors who fell

> victim to the blade and the bulldozer as the developer compounded the crimes in his weary enterprise by substituting through area grading, a flat uniformity of contour in contrast to the more interesting variations in terrain provided by nature.[13]

Table One on the following page is an example of typical existing development or layout specifications[14] which are designed to control low density, single-family suburban development, and which are the subject of the prededing criticisms.

Such criticism, however, is usually directed towards the regulations which dictate the spatial arrangement of improvements on individual lots and seldom offer more than a casual comment or two about the development and appearance of the access road allowance. Yet, it is the access road that provides a setting for the buildings alongside it and by so doing affects not only their appearance and livability but also their market value. Collectively, however, they determine the character of the study unit.

The lack of criticism with respect to the treatment of streetscape is more or less in keeping with the prevailing apathly towards public projects and things in our affluent society, and more than likely stems from the fact that streets are public or communal entities and thus of little or no concern to the individual beyond his property frontage, not to speak of streets in other parts of his neighbourhood and community.

TABLE ONE

REPRESENTATIVE LOT AND STREET DEVELOPMENT REGULATIONS [14]

Item	Regulation	Municipality
Zone	R 7200 single family	Ottawa & D. of N.V.+
Minimum area	7,200 square feet	Ottawa & D. of N.V.+
Minimum frontage	60 feet	D. of N.V.+
Minimum depth	120 feet	D. of N.V.+
Minimum allowable reduction	10%	D. of N.V.+
Front yard setback	25 feet	Richmond
Rear yard setback	25 feet	Richmond
Side yard setback	10 feet	Richmond
Maximum coverage: principal building	33 %	Regina
accessory building	10 %	Regina
Maximum height: principal building	35 feet	Regina
accessory building	12 feet	Regina
Location of accessory building	rear yard only	Ottawa
clearance from other buildings	10 feet	Richmond
Maximum height of fence: front yard	4 feet	Richmond
side yard	6 feet	Richmond
Street width and paving width	See Appendix A	D. of N.V.+
Utilities	See Appendix A	D. of N.V.+

Side lines should be at right angles to, or radial to the line of the streets.

Lot lines shall be continued through a block without jogs.

Jogs in street alignment shall be avoided.

Intersecting streets shall meet at right angles.

+ District of North Vancouver

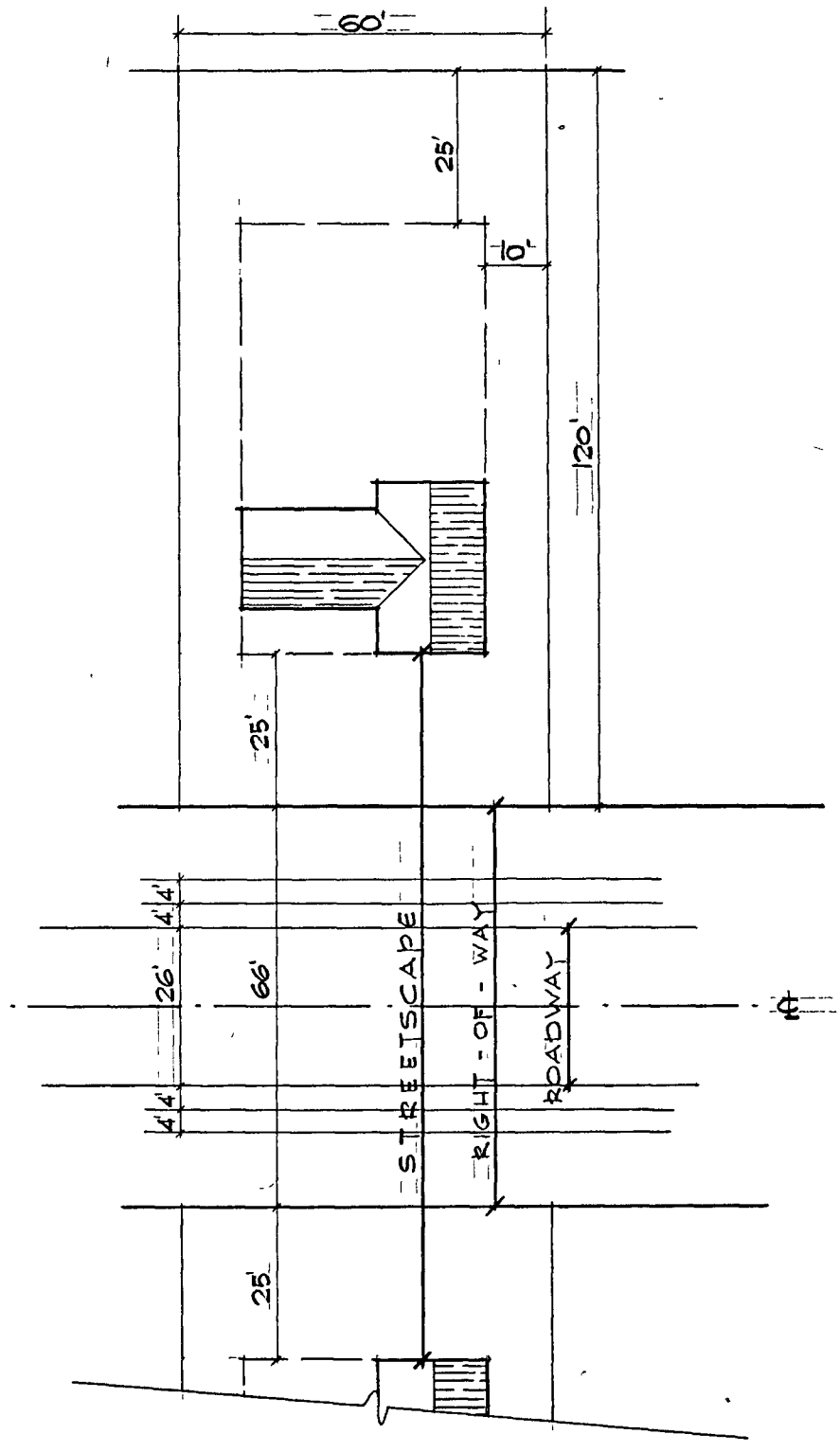


FIGURE ONE

STREET RIGHT-OF-WAY AND STREETSCAPE

The evolution of the Canadian street and streetscape has been an empirical process. It would be quite correct to say that most Canadian streets and roads "have grown from dirt roads into fully paved and serviced traffic arteries without the guidance of comprehensive (streetscape) development plans",[15] and that even today, in the age of rapid urban growth, most suburban streets are being constructed in a fragmented fashion. For example, following complete clearance of a right-of-way, the power and telephone companies install their overhead service lines simultaneously with the construction of the roadway and the installation of water mains, but the installation of gas mains, underground storm drainage, sanitary sewers, curbing, sidewalks, and boulevards will follow later and usually at odd intervals. Each new addition will naturally disturb the previous works and must of necessity be designed to fit around and about those already in place, thus increasing the costs and greatly delaying the emergence of completed streetscapes. Until a decade or so ago it was not uncommon for suburban developments in Canada to exist on basic services, i.e. access road, water, power, and telephone only. But because of recent explosive influx of population to suburbia most suburban communities have found it necessary to up-grade their existing services and to introduce additional ones through crash programmes. This means that soon the finishing touches will be given to streets and that no

further extensive disturbances of their surface components is to be expected. Consequently, here is the first, true opportunity, in the history of Canadian suburban development, to enhance and to secure environmental quality of suburbia through streetscape design. It may also be the only such opportunity in the current cycle of development.

This opportunity will require a careful appraisal of the current street development standards and practices as well as intensive studies of possible alternatives. Thus it should be the duty of the elected civic bodies to request such studies from their appointed advisors at an early date, but it should also be the function of the latter to bring this tremendeous opportunity to the attention of the elected members of councils. Unfortunately, however, this is seldom the case. It is common knowledge, that municipal councils have "vested" their right to control street design and development in their engineering or public works departments and that these, having devised a set of engineering servicing and development standards for their task, are quite reluctant to see them cast aside in favour of some new concepts of streetscape design. It is also common knowledge that these departments tend to give attention mainly to engineering matters and immediate servicing costs and that the total design of streetscape and its environmental characteristics has never been the subject of most municipal engineering specifications for suburban street development.

These engineering specifications, together with the zoning and sub-division regulations, are the prime moulders of the study unit environment in which both man and car exist. In Chapter Two these regulations are subjected to further analysis in order to determine their intent as well as their effect on streetscape and environment design.

Pedestrian Needs in the Study Unit

To-day's society is highly mobile and to an uninformed observer it may seem ridiculous to talk about pedestrian needs, especially in suburbia where the population may be said to be truly auto-oriented and auto-based. Statistics show, however, that despite the large number of cars the auto using population is considerably smaller in numbers than the non-auto using group of children, youths, and housewives who perform most of their daily travels on foot. Furthermore, as there are no adequate statistics readily available as to the number of cars in each household in any given area it may be accepted as fact that numerous suburban households are without a car during most of the day as the family car is commonly used for commuting purposes to and from suburbia by the household head. This renders at least two-thirds of the average suburban family autoless for a good portion of the day. Consequently, the pedestrian is still very much in existence in suburbia and because of the generally auto-oriented design of suburban streets quite

vulnerable to injury from circulation conflicts.

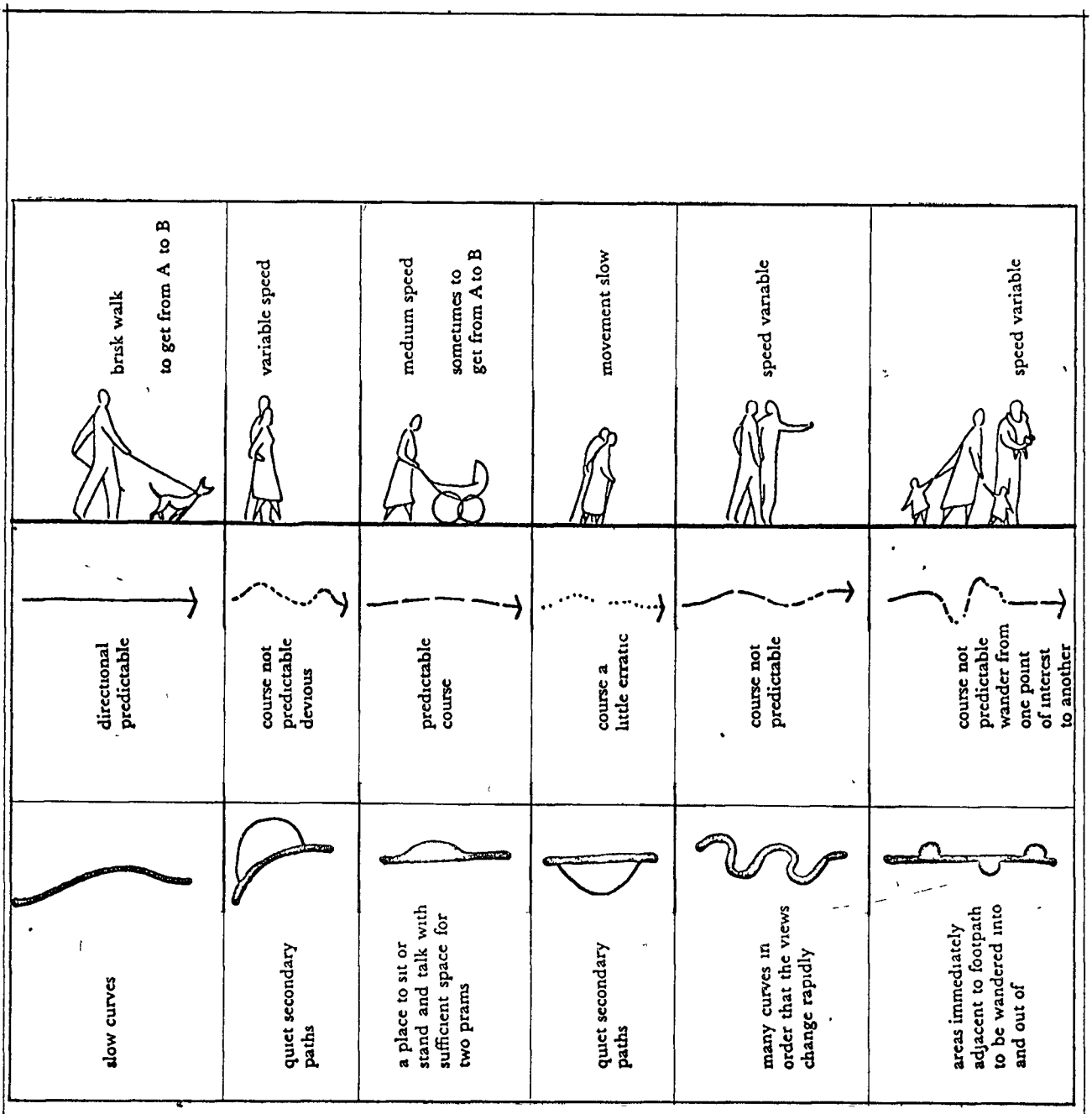
It may be argued that most pedestrian movements are short in distance and occur on more quiet and safe residential streets, and that major traffic arteries usually offer separate pedestrian pathways. This is quite true but, when considering the fact that a very large percentage of all pedestrian circulation is performed either by elderly citizens or by children on their daily trek to and from school, corner grocery store, tot-lot, or a friend's home next door, across the street or just around the corner it becomes obvious that even the so-called quiet residential street is not really safe and that the argument is at its best only a superficial one.

Besides the dangers evolving from traffic conflicts there are also other things within the study unit which have an effect on the pedestrian as well. Some of these may be pleasant and stimulating while others may have adverse effects. It could be the condition of the path's surface the pedestrian is compelled to walk on, or its texture and colour, or it could be the shape of the trees (or lack of these) which line his path along a street and by so doing open up unexpected views, screen out the unpleasant things, or frame and form vistas for him. For a homeowner it may be important that he can find privacy on his property when he so desires, or that his private domain not be subjected to undue effects from excessive traffic or any other disturbing cause beyond his control.

There are probably a thousand-and-one other factors which could be listed here but, for the purpose of this study it is assumed that it has been sufficiently substantiated that there is ample room and need for the improvement of the pedestrian and residential environment within the study unit. Figure Two on the following page shows diagrammatically some of the common needs of pedestrian circulation which can be expected to occur within the study unit.

Vehicular Needs in the Study Unit

Statistics show also that suburban population is highly auto-based, and much more so than its urban counterpart.[17] This should not be too surprising for it was the automobile which made suburbia possible but, what is stunning is the way the car has been permitted to rule and to dominate the suburban scene and the suburban street design, and this mostly at the expense of the pedestrian and his living environment. This dominance by the automobile stems partly from the way most suburban tracts were laid out (often well in advance of the automobile days) and partly from the way these tracts were and are being developed, i.e. without the guidance of an overall circulation plan, permitting vehicular movement in all directions on a network of residential streets rather than channeling traffic in a logical and directed manner from tertiary streets onto secondary and primary traffic routes. More recent subdivisions attempt to do this and it



F I G U R E T W O

SOME PEDESTRIAN NEEDS[16]

is a general consensus that the loop street and cul-de-sac are not only more pleasant residential streets but, also safer and more efficient from the traffic point of view.[18] But, even on this type of street the automobile has retained its dominance at least as far as street and roadway design is concerned. It appears that in practice there has not been enough thought given to suburban streetscape design and circulation needs, and evidence to support this statement can be found in the street development by-laws and engineering specifications of almost every suburban municipality.

Vehicular needs in the study unit are more or less analogous to the previously described pedestrian needs for they are really the needs of the driver, i.e. of an ex-pedestrian, in manoeuvring the car, and differ from his former needs mainly because of his new scale of mobility, the weight and size of his vehicle, and its limited mechanical manoeuvrability. The details and items which made up his on-the-foot environment have now to a large extent lost their singular importance and meaning to him and affect him through their clarity of organization and total visibility only, for his perceptiveness must now be geared and conditioned to the new dimension of increased speed. For example, the street trees, each with its own peculiar branch-and-twig patterns which used to attract his attention as a slowly moving pedestrian, now appear to him simply as a row of trees which he may, or may not, have time to recognize as to the shape, type,

etc., as these flash by in a rhythmic manner, and even the houses which through their colour and architectural frills previously used to tell him something about their occupants now appear, if he notices them at all, as a distant, jagged wall bordering his path.

In the study unit a driver's greatest obstacles are unquestionably children and domestic pets who may unexpectedly dart into his path from behind parked cars, hedges, and so forth, pedestrians walking on the roadway, or any other object which blocks his vision and path. Therefore, he needs an unobstructed and well defined roadway with clearly marked crosswalks, readable directive and warning signs and easily negotiated curves and grades. These are the basic techniques commonly used to improve the flow of traffic and to make circulation safer, yet, these alone do not make the study unit a safe or pleasant place, either for the driver or for the pedestrian. Instead, it usually happens that such techniques are conducive to higher speeds and volumes of travel and thus actually achieve the opposite of the desired results for the study unit. Consequently, the driver as well as the pedestrian needs his own environment for safe circulation.

The Conflict of Needs and Interests

The conflict of needs and interests stems from the fact that man is an organic being while the automobile is a mechanical device and that they both exist and operate in

the same environment, i.e. the study unit environment, thus placing two distinct sets of requirements upon it. There are, firstly, a myriad of items which make up a pedestrian environment where man can live and move about in a socially acceptable manner without being unduly affected by the actions of his fellow men, or vice versa, and secondly, those which provide for the necessary and safe operation and storage of cars within the residential environment without having an adverse effect upon it.

The order, or hierachy, of these two needs is not explicit in to-day's suburbia, but as the latter is a by-product or function of the first it would be only logical to expect it not to be allowed to act as the primary determinant for residential design and layout. It is obvious that the automobile is and should remain subordinate to man, i.e. it was built by man to serve man, and consequently all residential design should be directed towards the creation of a stimulating environment for living in which the car is to perform its function in the least obtrusive manner. Somehow, however, the automobile has started to dominate man's life and environment to a much greater extent than was ever visualized: not only do we use it for transportation, but we often also take our meals in it, bank in it, attend movies and religious services in it, make love and sometimes even give birth in it, but all too often also die in, or because of it. In other words, the car is very much a part

of our way of life, and because ". . . of its power, mobility, comfort, and plain good looks also the pride of most. . ."[19] of us.

> . . . we have all grown up with the motor vehicle, and it has grown up with us, so we tend to take it and its less desirabel effects very much for granted.[20]

These "less desirable effects" are the problems of safety, fumes and smell, and noise as well as direct and indirect environmental difficulties of conflicts arising from the presence of cars in the study unit.

Safety is universally accepted as a basic prerequisite for civilized life, and fumes and smells are generally considered to be health hazards, so not much needs to be said to promote their elimination from the study unit. This, however, is usually a very slow process which is highly dependent upon public awareness to the dangers involved and their willingness and ability to pay for the elimination of these adverse conditions. The greatest danger, however, lies in the general public tendency to accept the existing conditions and precautionary measures, if any, as adequated and satisfactory without a question, and it is not until a situation becomes really unbearable and dangerous that remedial action will be demanded and eventually taken. By that time, however, it may be too late to save a street or a neighbourhood for the adversities may already have changed its residential characteristics and depreciated the land and improvement values to a point where rehabilitation for a higher

density occupancy or for some other use may be the only feasible solution.

The need to make our streets as safe as possible for the purpose of circulation is understood and known by everyone for traffic accidents and physical injuries are a brutal and shocking force which is liable to strike anybody, anytime, and anywhere, causing grief as well as economical hardships. The high degree of consciousness to this danger and anxiety is partly due to the amount of coverage given to traffic accidents by our news media and partly due to personal experiences and observations but, neither has been, nor will be, capable of eliminating the perils completely.

> There has been a great deal of argument, to no great profit, as to whether it is the road or the road users that are responsible for the casualties. The answer is that both are to blame. The roads were not designed, nor are they fitted for modern traffic conditions; but, the roads being at this moment what they are, proportionate care ought to be exercised by road users. As such care is NOT exercised, and as it becomes quite clear that we shall not alter human nature, we must alter the roads. [21]

The need to minimize the adverse effects to health from vehicular fumes and smells is considerably less known because their disruptive and cumulative effects are not visual, i.e. these are considered, by the general public, to be more of a temporary nuisance than an actual danger because their intensity is usually quickly reduced by air movements. Coupled with the fact that humans have the

capability to respond to thousands of distinct odour stimuli they also have the tendency to become accustomed to prevailing odours in varying degrees which eventually will lead to a more or less complete acceptance of polluted air conditions as normal and therein lies the greatest danger to health.[22, 23, 24]

The problems of noise, and also of environmental conflicts are much more subjective and there is little scientific proof of and agreement upon their adversity upon humans. The British study of Traffic in Towns implies that there is ". . . little evidence to show that noise causes direct ill effects, or mental or nervous illness, . . ."[25] Paul Ritter appears to disagree with the Working Group by stating that "Noise made by vehicles is disturbing and offensive to man . . . a nervous strain."[26] The Working Group, however, distinguishes six main kinds of noise from vehicles[27], and comes to the conclusion that:

> . . . traffic noise is steadily developing into a major nuisance, seriously prejudical to the general environment of towns, destructive to the amenities of dwellings on a wide scale, and interfering in no small degree with efficiency. . .[28]

In practice it appears that action necessary to increase safety and to eliminate the adverse effects of odour and noise depends very much upon the degree of awareness of the problem and that it is not until "the cup runneth over" that attempts will be made to remedy the situation. Consequently, most remedial actions for the removal or elimination

of these adversities are after-thoughts, or defensive moves, rather than planned and deliberate actions to avoid the occurrence of undesirable situations from the beginning.

Other environmental difficulties on the suburban street originate from similar laissez fair attitudes and from general lack of other more preferable environmental examples. The universal acceptance of the automobile almost anywhere in the North American town has caused the British Working Group to say that:

> . . . in the United states, where so much has been done to create beautifully landscaped residential areas, the cars stand out all over the place and are accepted as part of the scene, . . .
> . . . . . .
> . . . There is nothing it can be held, in the experience of the United States, to suggest that frank acceptance of the visual impact of the motor vehicle is leading to the emergency of any new kind of brilliant, lively urban townscape. On the contrary it is producing unrelieved ugliness on a great scale. . . .[29]

The Urban Land Institute draws a parallel between the car and a new baby, and they maintain that because of its universal appeal and acceptance the automobile has been allowed to dominate the design of the suburbs, covering the land with blacktop and leaving too little space for people. To correct this obviously undesirable and unnatural situation they say that:

> Rather than allowing the car to convert our neighbourhoods into parking lots and rather than trying to outlaw the car from residential areas, we recommend that . . . development be designed to tame the car to serve its human master and to stay in its proper place . . . .[30]

The first of the two extreme and not recommended alternatives by Urban Land Institute needs no amplification as examples and consequences of this can be found in every community. The second extreme choice is less common as it requires maximum possible and preferably absolute segregation of vehicular traffic from that of pedestrian and only a few communities or development projects have achieved that degree of sophistication. Radburn, New Jersey, is undoubtedly the best known North American example of this type of development.[31]

A Canadian example, the most likely to fit this category, is Kitimat, British Columbia, where the plan incorporates not only the ideas of Radburn's traffic layout, but also the ideas and concepts of the Neighbourhood Unit, the Garden City, and the Green Belt.[32]

The possible range of options between the two extremes is of course infinite, just as are the techniques for achieving it. Somewhere within that range there must be an ideal concept for any community. Indeed, there must be a suitable one for every situation and any budget. Experience has shown that the two extremes are neither desirable nor economical and, consequently, it becomes imperative that a community determine and pursue a concept that suits both its needs and financial capability. Much depends upon the progressiveness of the local authorities; their awareness of existing and pending inadequacies, and above all, on their willingness to initiate corrective measures.

Summary

The automobile has proven to be one of the most important single influences which has ever shaped and directed growth of cities and ways of man. Its more or less unlimited availability, general acceptance, and popularity in North America have had not only catastrophic effect upon the modes of public transportation but, also upon the existing channels of circulation and the residential living environment, not to mention its effects upon the cultural, social and other aspects of every day living.

The universally accepted land-use controls of subdivision and zoning regulations as well as the common engineering standards for road construction, designed to provide for safety and health in a community, have resulted in a rigid and monotonous streetscape and residential environment, in which both the automobile and man exist and operate. These regulations have proven to be quite ineffective in providing satisfactorily for the needs and interests of the pedestrian as well as for the driver, i.e. the vehicle, with the consequence that there exist considerable areas of conflict.

In this Chapter an attempt was made to sketch briefly the basic needs and desires of man the resident, the pedestrian, and the driver in a suburban setting. The study of literature revealed that the problems of safety, fumes and smell, and noise resulting from the existence and operation

of cars in residential areas do have a definite bearing upon the quality of the residential environment. But it became apparent that due to a lack of scientific proof and simple ways of measuring these dangers in given situations these problems have been classified generally as subjective or abstract, and consequently, remedial regulations cannot be incorporated readily into the existing development controls. However, there seems to be a general agreement that ways and means are available to minimize these dangers to health and safety through quite simple aids which would not require more than some minor, but quite far reaching changes in the general approach to development, and that these must be effectuated as soon as possible.

Footnotes

[1]John Ormsbee Simonds, Landscape Architecture (New York: F.W. Dodge Corporation, 1961), p. 3.

[2]Arthur B. Gallion, The Urban Pattern (London, New York, Toronto: D. Van Nostrand Company, Inc., 1950), Part I, Chapter I, pp. 3-10.

[3]Kingsley Davis, "Origin and Growth of Urbanization", Metropolis: Values in Conflict, ed. C.E. Elias, Jr. et al., (Belmont, California: Wadsworth Publishing Company, Inc., 1964), pp. 8-18.

[4]Simonds, op. cit., p. 5.

[5]Davis, op. cit., p. 8.

[6]Steering Group, Traffic in Towns: A Study of the Long Term Problems of Traffic in Urban Areas (London: Her Majesty's Stationery Office, 1963), paragraph 55.

[7]Simonds, loc. cit.

[8]Province of British Columbia, Municipal Act (A. Sutton: Printer to the Queen's Most Excellent Majesty in right of the Province of British Columbia, 1964), Part XIII, Section 507.

[9]Ibid., Part XIII, Sections 505-515, and Part XXI, Sections 711-713.

[10]Ibid., Part XXI, Section 711 (1) (a) and (d).

[11]H.P. Oberlander and F. Lasserre, Annotated Bibliography: Performance Standards for Space and Site Planning for Residential Development, Division of Building Research, Bibliography #19 (Ottawa: National Research Council, 1961), p. (iii).

[12]Royal Architectural Institute of Canada, Report of the Committee of Inquiry into the Design of the Residential Environment (Ottawa: Royal Architectural Institute of Canada, 1960), paragraphs 57 and 61.

[13]Eldridge Lovelace and William L. Weismantel, "Density Zoning: Organic Zoning for Planned Residential Developments", Urban Land Institute, Technical Bulletin #42 (Washington: Urban Land Institute, 1961), p. 29.

[14]The development regulations and servicing specifications shown in Table One and Figure One are excerpts from Zoning and Subdivision By-Laws and Service Manuals analysed for the purpose of this study; namely those of Ottawa, Ontario; Regina, Saskatchewan; and the following Lower Mainland, British Columbia, municipalities: Burnaby, North Vancouver City, North Vancouver District, Richmond, and West Vancouver. The excerpts shown were found to be representative of the regulations employed by all the seven municipalities mentioned.

[15]Royal Bank of Canada Monthly Letter, Our Highways and Our Traffic (Montreal: Royal Bank of Canada, 1965), Volume 46, Number 1, p. 2.

[16]Paul Ritter, Planning for Man and Motor (New York: Pergamon Press, the MacMillan Company, 1964), figure 3.58.

[17]Occupied Dwellings (Households) Reporting an Automobile, 1961.

Municipality	Type	% of Dwellings reporting an automobile
Vancouver	urban	62.7
New Westminster	urban	68.5
Burnaby	suburban	79.3
West Vancouver	suburban	86.9
Richmond	suburban	85.5
North Vancouver District	suburban	88.4

Source: Dominion Bureau of Statistics, 1961 Census of Canada. Housing Characteristics. Volume II, Part 2, Pamphlet 5 (Ottawa: Roger Duhamel, F.R.S.C., Queen's Printer and Controller of Stationery, 1963).

[18]"In a study ... of 86 residential subdivisions representing 53,000 residents, subdivisions with the unlimited access of a gridiron-type street pattern have an accident rate seven times greater than subdivisions of limited access." Urban Land Institute, The Home Association Handbook, Technical Bulletin #50 (Washington: Urban Land Institute, 1964), Paragraph 11.52, quoting Harold Marks, "Subdivision for Traffic Safety", Traffic Quarterly, Volume XI, Number 3, pp. 308-325.

[19]Ibid., Paragraph 11.51.

[20]Working Group, Traffic in Towns: A Study of the Long Term Problems of Traffic in Urban Areas (London: Her Majesty's Stationery Office, 1963), Paragraph 22.

[21]H.A. Tripp, Town Planning and Road Traffic (London: Edward Arnold and Company, 1942), pp. 15-15.

[22]Melvin I. Weisburd and S. Smith Griswold, editors, Air Pollution Control Field Operations Manual (Washington: U.S. Department of Health, Education and Welfare; Public Health Service / Division of Air Pollution, no date).

[23]Harold W. Kennedy, The Formulation and Adoption of Reasonable Rules and Regulation (Chicago: Air Pollution Control Association, 1962).

[24]E. Sigarin, "Odour: A Proposal for Some Basic Definitions" (paper presented to the 57th Annual Meeting of the American Society for Testing of Materials, Chicago, Illinois, June 15th, 1954).

[25]Working Group, op. cit., Paragraph 26.

[26]Paul Ritter, op. cit., Chapter III, Paragraph 4.2.

[27]Propulsion, horns, brake-squeal, door-slamming, rattles from loads and bodies, and noise of tires on road surface.

[28]Working Group, op. cit., Paragraph 26.

[29]Working Group, op. cit., Paragraphs 33 and 35.

[30]Urban Land Institute, op. cit., Paragraph 11.5.

[31]Radburn, New Jersey, was started in the late 1920's and has since been the subject of both praise and criticism. Despite certain basic shortcomings it is commonly accepted as an example of desirable living environment. From the traffic safety point of view its record has been excellent: no fatalities or injuries of pedestrians or car occupants.

[32]B.J. McGuire and R. Wild, "Kitimat: Tomorrow's City Today", Canadian Geographical Journal, (November, 1959), pp.15-19.

CHAPTER TWO

CURRENT STREETSCAPE DETERMINANTS

Circulation Patterns

In theory, the roads and streets of a nation or of a city are comparable to the system of blood vessels in a human body: they are the communication links along which goods and people move from one area to another and so knit the various components of a nation into a single entity, or unit. In Canada, there are close to half a million miles of roads and streets but, the network of these is far from being as complete or sophisticated as that of the human body in which, for example, the dimensions of channels are in accordance with the volume of flow.

> . . . Canada is the only country with a large car population that has no federal highway authority to plan highways, give advice on standards, and correlate the provincial highway building activities. . . .[1]

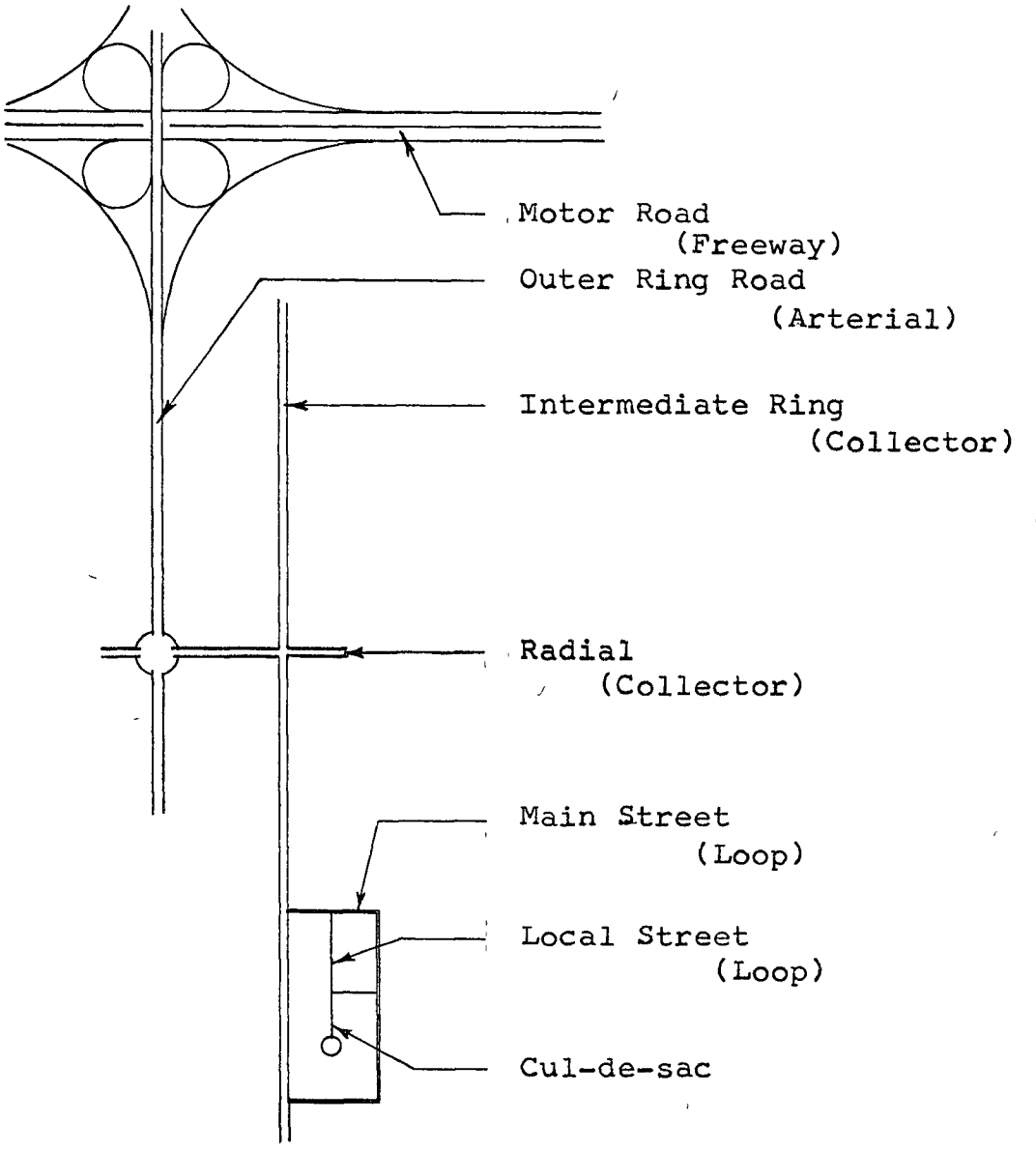
Consequently, the Canadian road pattern has evolved from local needs, handicapped by lack of knowledge, lack of funds, and lack of co-operation between the authorities

whose areas adjoin. It exhibits every known method of construction and many quality standards.

Yet, as was indicated in Chapter One[2], the Nation's roads do exhibit a definite hierarchy even if it is made up of provincial and municipal road systems. The primary purpose of each one of these systems is to satisfy the needs for circulation in their respective locales and this is clearly reflected in both their location and quality standards. The only exception to this practice is the inter-provincial Trans-Canada Highway which was constructed with federal subsidies from coast to coast to uniform standards especially developed for this purpose.

The street network of a municipality is part of both the unofficial federal road hierarchy and its provincial counterpart and usually possesses a hierarchy of its own, a schematic example of which is shown in Figure Three on the following page. The principles of this are explained by Kevin Lynch in the following manner:

> The conventional hierarchy of urban streets begins with the cul-de-sac, loop, or minor street which gives access to the low-intensity uses fronting on them. The minor streets lead to the collector where local centres are located, but on which uses such as houses may still front. The collector empties into the major arterial, built for heavy flows, with intersections at longer intervals, intensive fronting uses, and access controlled but not excluded. Any low-intensity use on an arterial will front on to an intervening service road. From the arterial one enters the freeway, with widely spaced grade separated intersections and no fronting access.[3]



F I G U R E T H R E E

ROAD HIERARCHY

Adapted from L.Keeble[4]

Regrettably, however, it must be said that despite the obivious benefits to be gained from such a street hierarchy not many communities do actually possess one in its complete and true form. As was indicated earlier, most North American towns inherited their street networks as a result of premature and speculative subdivision, well in advance of the automobile as well as in advance of a clear and complete understanding of the interaction of various components of a community.[5] Obviously, the hierarchy was developed as an after-thought rather than as a built-in device, but it has been employed quite successfully in many instances, e.g. in larger, planned unit developments. However, these are too few and far between to have any noticeable effect upon the circulation pattern of most communities. The larger portions of urban settlements, i.e. the urban and suburban areas with more conventional street layouts, have so far not received any direct benefits from these. Indeed, it may even be advanced that planned layouts, with their designed traffic arteries and consequent ability to move greater volumes of traffic more quickly, have had an adverse effect upon the more conventional connecting streets which cannot handle similar volumes of traffic as successfully, i.e. the traffic is forced to seek new and alternate routes to avoid bottlenecks and so lessens the environmental qualities of these routes and increases the chances for conflict.

> . . . The authorities, desparate for remedies, instigate traffic management schemes which 'spread the load' by diverting traffic over a wider network of roads. But this frequently introduces heavy traffic into streets which have an environmental function, with harmful results for the people living there. . . .[6]

The most common residential layout in a North American town is, of course, that of the uniform rectilinear grid, but there are also other less common types such as triangular, radial, or some modified forms of any one of these. Each one of these inherited systems has its own positive as well as negative characteristics, but their most common faults lie in their mathematical uniformity of dedicated rights-of-way and block patterns which do not recognize the need for a hierarchy of circulation paths in accordance with the volumes and desire lines of either the vehicular or pedestrian traffic. In other words, there have been no real opportunities for traffic engineers and planners to design proper and complete circulation networks and the majority of to-day's traffic channel patterns are only attempts to impose some order into the already existing, and for this purpose ill conceived, layouts and their extensions. The National (U.S.) Committee for Traffic Safety makes this point in their manual, Building Traffic Safety into Residential Developments, by saying:

> . . . Most effective results can be obtained only through original layout and design. . . . certain corrections can be made after the residential area has been developed and lived in, but measures taken then are generally either expensive or are only palliative which produce, at best, ineffective traffic results. . . it has not been possible to overcome bad original design. . . .[7]

Theoretically, it should not be impossible nor impractical to adopt a hierarchy of traffic arteries for any community. In most suburban municipalities in Canada there should be ample opportunity for this, particularly in communities where the installation of necessary utilities is fast approaching completion, and where the final roadway is to be put down next. Such a project would be, however, an immense undertaking in any community and it would more than likely run into considerable opposition and criticism regardless of the benefits to be gained as it unquestionably would upset the established and accepted living and driving patterns to no small extent. In all probability its defeat would not come from the lack of capital or the expenses involved, but rather from the difficulty of "selling" the idea to the public, their elected civil leaders and appointed administrators.

The most common right-of-way width in residential suburbia is in itself more than adequate for access and circulation purposes, but it is too narrow to accommodate larger volumes of through traffic in a satisfactory and safe manner. The efficiency of the present suburban networks is further reduced by the lack of visible physical differentiation between heavily travelled and lightly travelled routes, i.e. due to the uniform widths of the rights-of-way and roadways it is often impossible to tell which road is a through road, or a collector, and which is a local street

or even a cul-de-sac. Furthermore, the grid layout permits unlimited points of ingress and egress and thus greatly reduces the carrying capacity of streets and increases the possibility for accidents and conflicts.

This, coupled with the established practices to clear all access rights-of-way to their full width for the purpose of easing the installation of utility services, and the uniform application of regulations, which control development of abutting properties, has had also a definite effect upon the visual characteristics and environmental qualities of residential streets. Because of the general reluctance to change established development policies and engineering practices these characteristics have also been carried over to newer residential subdivisions which themselves often do have planned circulation channels. This general absence of physical differentiation between the different kinds and types of streets, has also made the newer developments, with their modified grid patterns and meandering streets, extremely difficult to orient in, and consequently it may be said that some of the benefits gained through better layouts are at least partially lost.

Most existing conventional layouts have also ignored the desire lines of pedestrian traffic and, therefore, the pedestrian has been compelled to follow the routes and paths of vehicular traffic. This adversity led to the conviction that complete disassociation of foot and vehicular traffic was

both desirable and necessary and resulted in planned communities and developments where systems of walks are completely divorced from the vehicular networks, e.g., Kitimat, British Columbia. Experience has shown, however, that absolute segregation of the two modes of traffic is neither desirable nor obtainable in suburbia, except for the conventional, clear separation of the roadway and its boardering sidewalk. This does not imply, however, that horizontal or vertical segregation may not be necessary at points of conflict where volumes of one or both are so great that unmanageable and hazardous situations occur.

In addition to providing for pedestrian and vehicular access and circulation most public rights-of-way also contain networks of a number of utility service lines. Their number varies from community to community and from development to development in accordance with the quality of each. But it is common for a suburban, residential street to carry no fewer than four utility service lines undergound, two on the surface,, and four or more above the surface.[8]

The principal function of these utility networks is to serve the improvements abutting the rights-of-way and, therefore, these networks are also by-products of suburban (residential) development and should be installed in a complementary manner, and not so that their presence will have undesirable side effects upon the surrounding environment. Unfortunately, however, this is not usually the case. Long established and accepted installment practices have rendered

the adoption of more modern and practical methods an economic impracticability for a long time to come,[9] and thus the utilities within the public rights-of-way continue to be the chief spoilers of both the present and future residential environments and streetscapes.

The technical aspects and the methods of installation of these service systems are not the subject of this investigation, and are referred to only when expedient to clarify aspects of streetscape and environmental design.

Street Development Standards and Practices

In British Columbia, as was demonstrated in the preceding Chapter, the Municipal Act does not impose standards for the width of street rights-of-way[10] and consequently, it has been the responsibility of each local authority to draft and to adopt adequate and suitable standards for this purpose. But, the possibility of a municipality securing adequately dimensioned rights-of-way for a hierarchical system of streets is nullified by the Act, which also states in part that

> Where land is being subdivided, the owner shall not be required on subdivision to provide without compensation for the purpose of a highway allowance within the subdivision, land exceeding in depth of sixty-six feet; . . .[11]

Thus, without actually specifying any limits the Act quite effectively advocates the continuation of the sixty-six foot street rights-of-way practice, which was introduced to the North American scene by the pioneers and early

surveyors.[12] As it is beyond the budgets of most communities to compensate owners of land for additional rights-of-way area there is a universal tendency to be content with the authorized allotment. In a similar vein, it is customary also for a municipality to acquire the maximum permissible allotment even though it is known to be excessive for road construction purposes.

Generally speaking, however, the absence of senior government imposed standards has proven not to be a serious handicap as most townsites, including many suburbs, already have legally dedicated road allowances, and their dimensions, quite naturally, have been adopted also as standards for future street rights-of-way. The lack of dictated standards has, in fact, in many instances been of great value to environment and streetscape design and has given rise to some very pleasant residential subdivisions, eg. the Caulfield area in West Vancouver, British Columbia, where with only 20-40 feet wide road allowances and 12-16-foot pavements it has been possible to create a park-like setting for residences. This example is, unfortunately, an exception rather than a common occurrence and undoubtedly much credit must be given to the original subdivider and the civic officials of the Municipality of the time.

Instead of relying upon private and local necessities or preferences, most municipalities have pursued "the-bigger-the-better" doctrine of yesteryear when wide streets were

considered to be a sign of prosperity and when power poles symbolized progress. The municipal engineering profession, having once established their standards for road development along these lines, is understandably reluctant to amend its ways for this would mean considerable changes not only in the road design process itself, but also in the allied fields of utilities, their manufacture, and so forth. And presently, with the tremendous population growth in suburbia, their hands are full of various other design jobs, e.g., sanitary sewer systems, for which incidentally, the wide road allowances are considered to be ideal.

As was mentioned earlier, the elected civic officials have vested their right to develop roads in their engineering departments.[13] Some of these departments in turn have found it most convenient to make wide use of road development standards drafted by the Canadian Good Roads Association whose prime objective it has been

> . . . to promote efficient highway design in all parts of Canada by the use of standards that will provide a greater degree of uniformity in road design practice than exists at present. . .[14]

It is of importance to note here that the emphasis is on uniformity for the sake of efficient highway design, and that the quoted statement not only reflects the prevailing attitudes of the local municipal engineering specifications investigated for the purpose of this study, but also the general appearance of North American streets. Unquestionably, the engineering textbooks must discuss the effect of roads and streets on the traversed landscape and environment

but it is most disturbing to discover that a manual for office use hardly makes any mention of this important aspect of street and environment design. It simply states that "no attempt has been made to discuss the purpose, scope or method of highway planning or of land use planning", [15] and that

> . . . It is essential, however, that the design of a road be preceded by proper planning studies to determine the nature of the service to be provided. . . [16] [17]

The main concern here appears to be with the technical aspects of the roadway design, i.e. with its structural adequacy and quality rather than with its functional adequacy, suitability, and impact on the development it is to serve. This lends further support to the previous statement that the design of total streetscape is not yet recognized to be an integral part of the municipal engineering process by the profession itself although the development of urban and suburban streets has been entrusted to them by the taxpayers via their elected representatives.

The Canadian Good Roads Association manual, in classifying roads, distinguishes first of all between urban and rural roads of which there are 16 and 18 respectively. The urban classification, of main interest to this study, is divided into four categories, namely the freeway, the arterial, the collector, and the local. Each one of these is again broken down according to type and design speed, as is shown in the following Table.

TABLE TWO

URBAN ROAD DESIGN CLASSIFICATION [18]

Class	Type	Design Speeds			Min. & Max. R/W widths
Freeway	Divided	70	60	50	150' - 300'
Arterial	(Divided	60	50	40	108' - 142'
	(Undivided	50	40	30	83' - 131'
Collector	(Divided	50	40	30	104'
	(Undivided	50	40	30	74' - 98'
Local	Undivided			30	50' - 66'

From the above Table it can be seen that the Association acknowledges the need for a variety of road types in an urban setting, but it is also quite obvious that it does not recognize the fact that most urban centres have inherited layouts with already dedicated right-of-way widths which cannot possibly meet their recommended standards. To acquire the additional strips of land necessary to meet their recommendations through expropriation would be in most cases an economic impossibility, and furthermore, the acquisition of portions of abutting properties for right-of-way purposes would, more than likely, also render the affected parcels of land non-conforming as far as their areas and depths are concerned. Consequently, there are only two practical or economic alternatives open to a municipality; either to enter into extensive replots of properties affected; or to make use of the existing rights-of-way for wider pavements than recommended by the Association.

The latter appears to be the universal choice as only a few communities have adventured into the field of replotting[19], which is a slow and involved legal and administrative process.

From Table Two, on page 53, it can be seen that only a single type of local access street is recommended: that of the undivided type with a design speed of 30 miles per hour. The Association advocates, however, that three pavement widths could be used on local access streets: a 22-foot wide pavement on short culs-de-sac with no curb parking; a 30-foot pavement on conventional access streets in single-family residential areas where parking is permitted on one side of the roadway; and a 38-foot wide pavement in areas of multi-family housing. In all instances, except in the case of the cul-de-sac where the recommended right-of-way width is 50 feet, the Association suggests a right-of-way of 66 feet[20]. There is no reason given for these recommendations, and it seems most illogical that in low density residential areas the road allowance should be up to 127 per cent wider than the recommended roadway width. Unquestionably, there are instances when wider rights-of-way are needed for cuts, fills, and so forth, but these are usually local, isolated instances and problems dependent on topography and drainage conditions, and there appears to be no real objective in establishing excessive, nation-wide standards, to cover these. Their

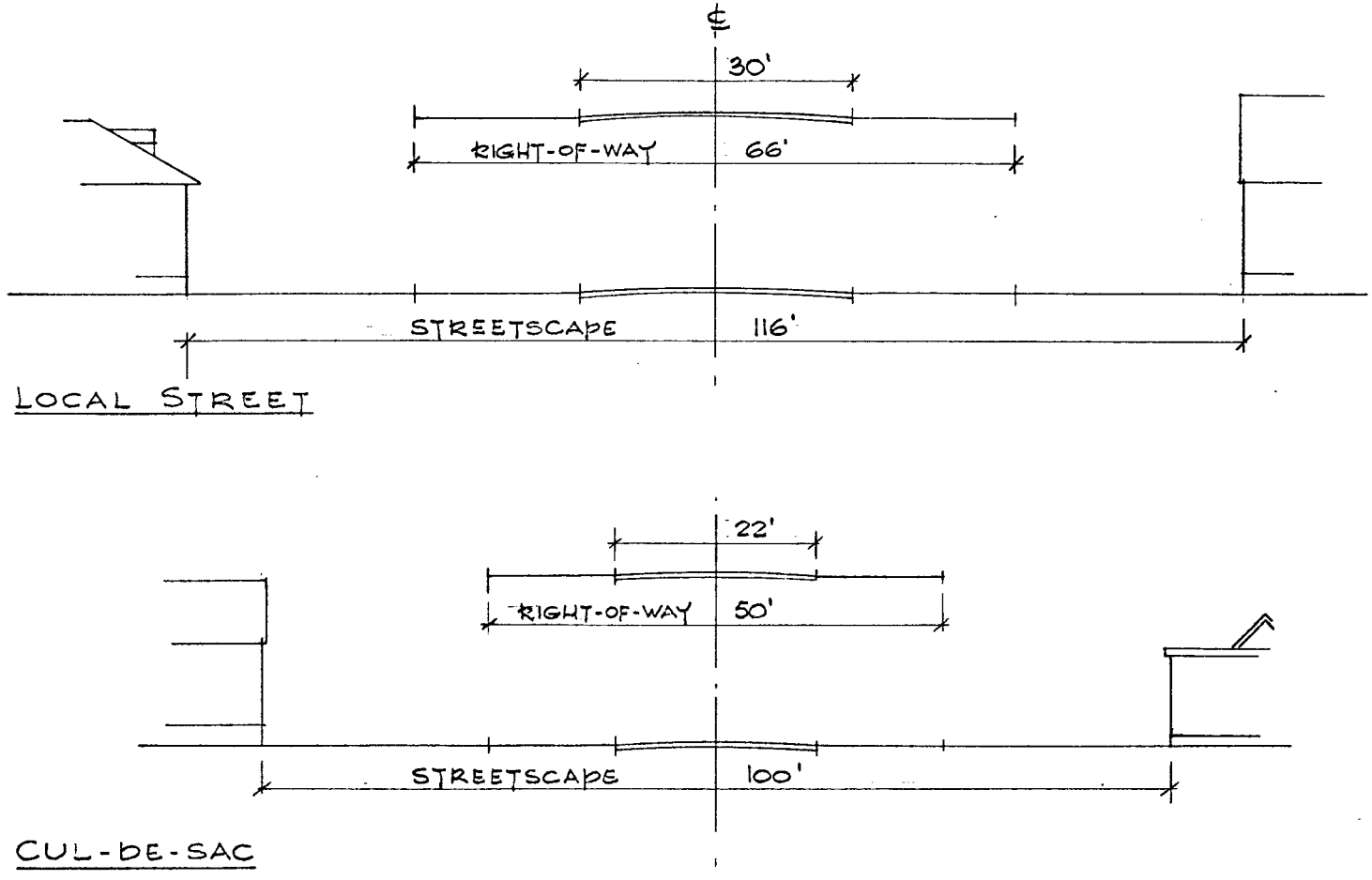
recommendations for local single-family streets are shown graphically in Figure Four on the following page.

Another manual [21], which claims not to be a set of standards but rather a guide to developers and civic officials alike, has been prepared under the auspices of the National [22] Committee for Traffic Safety. It displays a different concept and approach to the development of residential streets.

> The provision of attractive homes in residential subdivisions . . . is not incompatible with high standards of traffic safety. On the contrary, the absence of traffic hazards and inconveniences will enhance these qualities of "livability" and so improve property values . . . [23]

This manual proposes that all local single-family streets have a right-of-way width of 50 feet with a 26-foot pavement, and that all collector, or feeder, streets have a 36-foot roadway in a 60 feet wide right-of-way. Of interest to this study is also their recommendation that "as a general policy, parking facilities should be provided off the street . . . for parking at the curb is costly" [24].

Table Three, on page 57, summarizes the recommendations of the two manuals discussed for comparison purposes.



F I G U R E F O U R

RECOMMENDED RIGHT-OF-WAY DIMENSIONS [14]

T A B L E T H R E E

COMPARATIVE SUMMARY OF STREET DESIGN RECOMMENDATIONS FOR LOCAL ACCESS STREETS IN SINGLE-FAMILY RESIDENTIAL SUB-DIVISIONS[25]

	C.G.R.A.*	N.C.T.S.**
Street width:	66'	50'
Pavement:		
width	30'	26'
location		
% of total street width	45.5	52.0
Sidewalks:		
width	4'	4'
setback with trees	7'	7'
setback without trees	not given	3'
Maximum grade:	8%	8%
Cul-de-sac:		
maximum width	50'	50'
maximum length	not given	500'
turn around with parking	52'	50'
turn around without parking	not given	40'

* Canadian Good Roads Association

** National Committee for Traffic Safety

Local authorities, of course, are faced mainly with the development of 66-foot road allowances, unless plans cancellations, replotting, or the opening up of new and unsurveyed parcels of land has taken place and new road allowances of lesser dimensions have been established. Investigation of the local practices and standards showed that the width of pavement varies both from municipality to municipality as well as with the density of development

and degree of servicement. For example, a local 66-foot residential street without sanitary and storm sewerage systems usually has only a 20-foot paved surface with 9-foot gravel shoulders on each side of the pavement while a completed access street with all services in place has a paved roadway that measures 34 feet inside the bordering curbs[26].

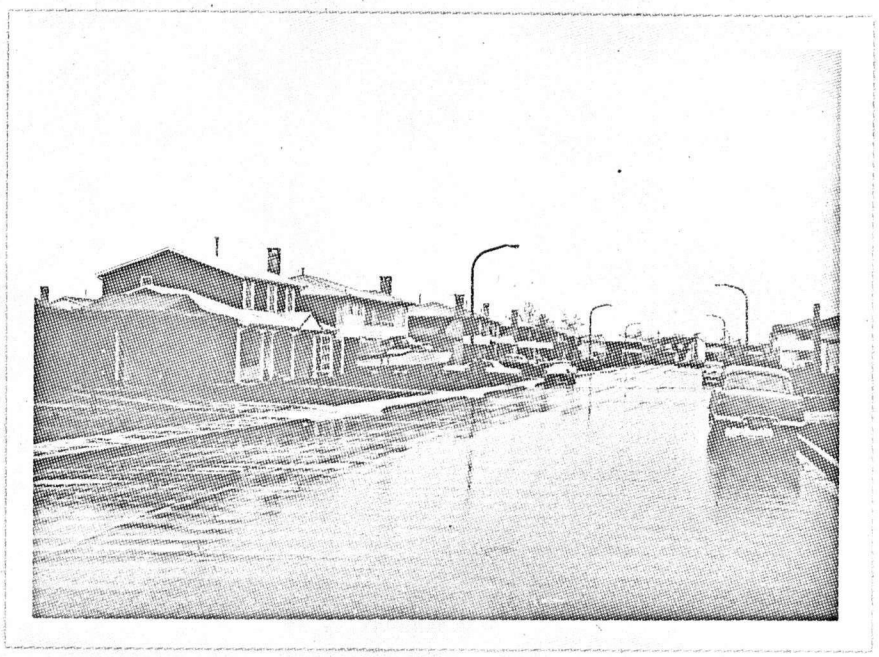
The above mentioned pavement width appears to be too excessive for local single-family streets in more ways than one. Firstly, the initial paving costs, as well as the future maintenance costs of the 34-foot roadway are 20% higher than of a 26-foot pavement[27], and secondly, the 34-foot pavement provides a 10-feet wide parking area and two relatively wide moving lanes which under normal circumstances in a residential setting can handle up to 300 vehicles per hour each, for a total of 600 vehicles per hour in two directions[28]. Such volumes of traffic are most unlikely to occur and above all, should not be allowed to occur on local residential streets. The parking lane will accommodate in the typical setting of the study unit approximately 20 cars at the curb on one side of the street, exclusive of the frontage required for driveway entrances. This equals one on-the-street parking space per dwelling in a 60-foot frontage study unit in addition to the two effective off-street parking spaces usually found on each lot, giving a total of three spaces per dwelling or a grand total of 60 spaces per study unit. Such practice is

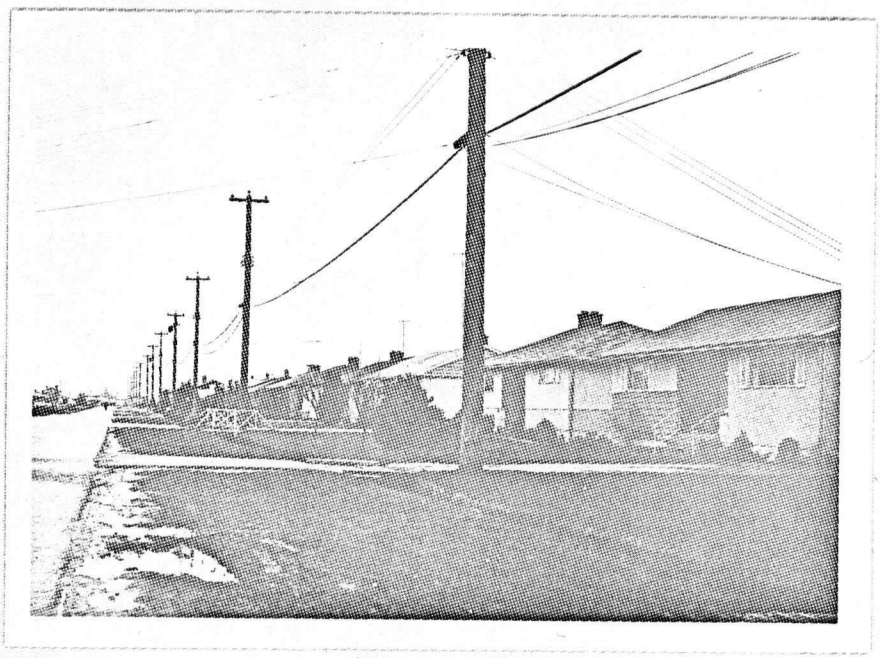
wasteful as well as unnecessary and has caused the Community Builders' Council to say:

> There is a tendency in many municipalities to require excessive widths for minor single-family residential streets. This is reflected in a similar tendency to require excessive roadway pavements. . . . minor streets rights-of-way in residential neighborhoods of single-family detached houses should not exceed 50 feet with roadways not greater than 26 feet from face-of-curb to face-of-curb. . . . . . . car parking space must be provided by individual driveways provided on each lot; hence, the 26-foot pavement width is sufficient for slow-moving traffic and for one lane of parallel curb parking[29].

The excessive pavement width has at least one more adverse effect upon the residential environment: it invites fast travelling; and the general absence or lack of parking directives on local suburban streets, permitting parking on both sides of the roadway, considerably reduces safety by forcing the traffic to meander between parked cars. Extensive field trips to various neighbourhoods in the Lower Mainland Region of British Columbia during the survey and inspection phase of this study revealed that local residential streets are to a large extent not being used for parking purposes and that adequate parking is being created on individual lots — at least today when the two garage house with a double width driveway is the best-seller in suburbia. This tendency, naturally, helps to emphasize the excessiveness of the roadway as well as that of the right-of-way and points to the meaninglessness of such provisions and public expenditures.

The photographs on the following page, Figure Five, are examples of typical streetscapes and pavement widths.





F I G U R E F I V E

EXAMPLES OF TYPICAL STREETSCAPE AND PAVEMENT WIDTHS

Investigation of street development practices showed also that there are no real attempts being made to create streetscapes of different character, either by design of layouts to complement the improvements, or by retention of some of the natural characteristics, e.g. vegetation, in order to create a setting for the dwellings along it and give the residents better opportunities to solve their own landscaping problems. For example, the engineering specifications of one local municipality that often is envied for its magnificent wooded (undeveloped) areas by others less endowed, requires that:

> Unless otherwise specified, the entire area of the right-of-way shall be cleared of all trees and brush, by complete removal or burning.[30]

The above regulation does, naturally, not rule out the retention of some of the natural vegetation, but nevertheless, it is a negative approach that has done little or nothing to erase the bulldozed image of suburban developments. This method of developing virgin areas is in all probability the cheapest initial method of tackling new areas and, unfortunately, is also used by great many developers in clearing their building sites, with the consequence that the emerging suburban living environment is barren and in this climatic region particularly vulnerable to erosion, requiring heavy capital investments in retaining walls, drainage work, and so forth. It cannot be denied that initial complete clear-

ance has certain advantages also, e.g. it allows sun to reach the ground, air to circulate, and removes the weak-rooted forest grown trees, but many of its later repercussions are now becoming apparent at ever increasing rates. For example, now that suburban crash programmes for the installation of necessary utility systems is rapidly nearing completion, more and more residents are beginning to ask for "les essential" services, or amenities, e.g. ornamental and shade trees on boulevards. Thus, the initial, bulldozer-mentality development cycle has reached a stage where trees will be re-introduced to the streetscape, and result in additional annual public expenditures, some of which at least could have been avoided from the beginning by a more sophisticated approach to the problem.

The technical and economic aspects of providing underground hydro and telephone service are beyond the scope of this study[31], and it must suffice to say that investigation revealed that local authorities

> . . . may by by-law regulate the use of highways by a . . . electric light, telephone, . . . power. . . company. . . . . .
> . . . . . .
> . . . regulate the placing or replacing of poles, towers, structures, wires. . . and the like on, in, over, under, or along any highway. . .[32]

and that

> . . . with the assent of the owner-electors, may by by-law require persons operating telephone, electric light, or power utilities, . . . to place underground any or all existing wires and means of transmitting electrical current or energy.[33]

and that

> A municipality which has adopted such a by-law. . .shall pay the cost of removing and replacing any existing means of transmission,. . .[34]

It is obvious that the cost factor will postpone the immediate removal of overhead utilities but the decision to place new utility lines underground rests solely with the elected civic officials. Again, it must be noted, that it should be the duty of their technical advisors to bring the disadvantages of overhead systems to the attention of the elected civic authorities. But the municipal engineers, being charged with street development, are more concerned with providing the service than with the manner in which this is being provided or with the effect it has on the surroundings. From interviews it was concluded that, although they have no real objections to buried wires and cables and ornamental street lighting fixtures, they do not go out of their way to get these. Indeed, despite their authority to regulate the placement of poles, and overhead wires and cables within the street rights-of-way, they check all pole permit applications by utility companies against possible interference with their own surface and underground utilities only. The effect of overhead utility structures and servicing components on the surroundings is still classified as a "subjective matter" and, therefore, may be said to be outside the realm of engineering and servicing. The placement of other items of street furniture, within the limits of

street rights-of-way is commonly handled in a similar laissez fair fashion, and often with quite unfortunate side effects on streetscapes and surroundings.

Development Controls and Streetscape

The most common tools for controlling and regulating the use and development of land and improvements in suburbia are the conventional zoning and subdivision by-laws.[35] Subdivision by-laws deal mainly with the plotting of larger parcels or tracts of land (and the establishment of access rights-of-way) in accordance with the requirements set forth in zoning by-laws, which themselves are designed to control the usage and development of both the land and improvements on each parcel so created.

It should be pointed out here, once again, that in British Columbia the Municipal Act delegates the full responsibility to devise and to adopt appropriate regulations for the control of local development to its municipalities, and that it only specifies how and in what manner these regulations are to be applied. The Act states in part:

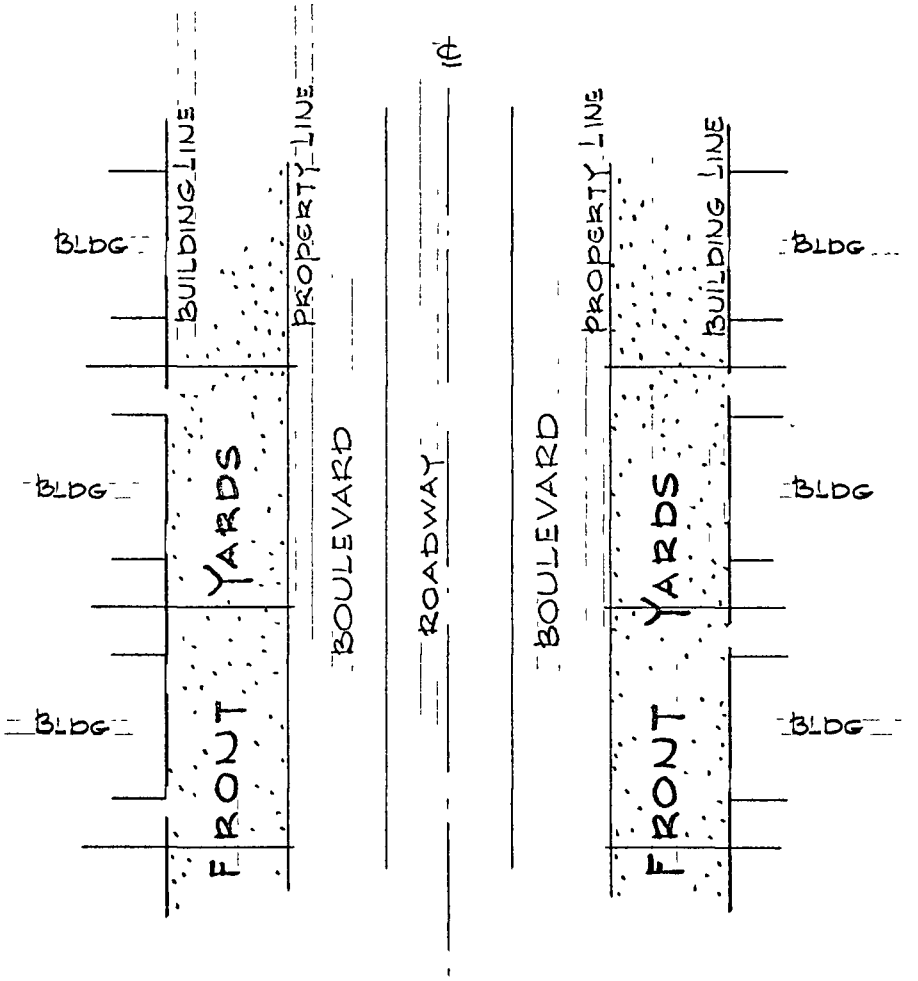
> The Council may by by-law . . . divide . . . the area of the municipality into zones . . .
> . . . . . .
> regulate the use of land, buildings, and structures, ... within such zones, and the regulations may be different for different zones, and for different uses within the zone. . .
> . . . . . .
> regulate the size, shape, and siting of buildings and structures within such zones, and the regulations may be different for different zones

> and with respect to different uses within a zone. . .
> . . . . . .
> require the owners or occupiers of any building in any zone to provide off-street parking. . .
> . . . . . .
> regulate the area, shape and dimensions of parcels of land and the dimensions, location, alignment . . . of highways in connection with the subdivision of land and may make different regulations for different uses and for different zones of the municipality . . .[36]

For the purpose of this investigation it is assumed that the study unit is located within a homogeneous single-family residential neighbourhood, or zone, and thus all development of the abutting properties is controlled by identical regulations, namely, those shown in Table One, page 20. These regulations are of interest to this study only insofar as they affect the design, development, and the appearance of the study unit i.e. the streetscape, and will not be subjected to more extensive analysis. Thus the main concern here is with the regulations controlling the development of front yards, i.e. the area between the front lot line and the required set-back line, often also referred to as the building line; and as shown in Figure Six, on the following page.

It should be understood clearly that the required set-back dimensions in by-laws are intended to be minima and that they are not inflexible standards. Therefore, a owner or builder has the option of locating his building, if he so desires, further back from the front building line

as long as by so doing he does not violate the rear or any other yard requirement.



F I G U R E S I X

FRONT YARDS

This flexibility makes it possible to widen or to expand a streetscape by the placement of dwellings further back in a study unit, and it also permits grouping of dwellings along a street through a variation of set-backs. It does not, however, permit a reduction in the width of a streetscape as any departure from the customary siting practice can only take place within the building envelope on the private lot; there are no provisions for locating dwellings partly outside the limits defined by siting regulations. Consequently, it has become a general practice to place the principal buildings right on the front building lines in order to make the back yards as large and functional units of private open space as possible. And this is done usually without regard to their orientation to the sun and other micro-climatic factors.

From the above it can be concluded that the conventional zoning regulations do provide for a certain degree of flexibility in the dimensions of streetscape, but also that this flexibility is possible only at the expense of the abutting properties. Furthermore, the effects of this flexibility are limited and can be employed, to the fullest advantage, only in a study unit that is being constructed wholly by one developer, i.e. as a planned study unit.

Clive Justice, a well known local landscape architect, stated at a panel discussion:

> The trouble is that the regulations we have inherited have no reference to our present pattern

> or urban living. . . . One thing we've neglected in our regulations is the orientation of our homes — that is, how we face our climate. There are entirely different climatic conditions on the north and south sides of the street, for instance, but same regulations exist regarding setbacks, yard allowance, etc. That doesn't make sense, . . . The north side of the street should have no setback at all.[37]

Inquiries as to the reason for retaining such excessive (commonly 25 per cent of both the area and depth of a lot) front yard or setback regulations revealed that the present practice is simply a continuation of the convention that is founded on an inherited desire to avoid the reoccurrence of the drab living conditions of earlier industrial settlements. There seemed to be a general agreement among those civic administrators queried that the present absolute and arbitrary set-back regulations prohibit meaningful usage of considerable portions of private property and that such regulations should really relate to a number of factors, such as the size and shape of the lot, the bulk of the proposed improvement, the characteristics of the access street, and so forth.

The literature examined in the course of this study suggests that adequate and more functional space around and between dwellings can be achieved through the employment of a set of regulations based on the performance of buildings,[38] but it also suggests that the application of such performance standards in the field would be a much more difficult

and complex task than is the administration of the currently employed conventional zoning regulations.[39] There are no indications as to the time when such a system of performance standard regulations will be ready for adoption by the municipalities and, even then, it will be questionable if the civic authorities themselves will be ready and willing to cast aside their present, proven tools in favour of a new and unproven one, despite its obvious superiority. One obstacle to a speedy acceptance of such a system by municipalities can be expected to arise from the fact that it can be employed effectively only to regulate new developments and renewal schemes and that it has little to offer areas which are already fully or partially developed, i.e. the existing suburbia. Consequently, it may be said to be essential to amend at least some of the conventional and the more arbitrary development regulations in order to make it possible to eliminate, or to lessen some of the adversities that are known to exist in the present suburbia.

Of particular interest to this study, as was mentioned earlier, are those zoning regulations that affect and determine the characteristics of streetscape in a study unit, which, for the purposes of this study, has been defined to stretch from the front of buildings on one side of the street to the front of buildings on the opposite side of the street.

> The landscape of the street is bounded, not by the right-of-way lines, but by the buildings which front on it. . . .
> . . . . . .
> . . . the typical suburban street, lined with one- and two-storey castles of Cinderella, modern, of ranch house persuasion, includes landscaped front yards, . . .[40]

Therefore, the effective suburban streetscape is commonly 110 to 126 feet wide, and this makes it about five times wider than the roadway it contains. Such excessive widths are considered to be wasteful and quite unnecessary[41] as well as out of scale with the surrounding development.

> The modern street dominates our communities visually whenever its width from building to building exceeds about twice the height of those buildings.[42]

The zoning regulations controlling the development of front yards were found to prohibit all meaningful private usage of these yards, except for purely ornamental or decorative purposes, i.e. landscaping. The erection of accessory buildings or other structures in the front yards for private use, or for successful protective enclosure, is not allowed for this is alleged to constitute an infringement upon public safety, the visual aspects of a study unit, and so forth. In other words, home-owners are compelled to render and to maintain their front yards for semi-public purposes, or community benefit and image, yet by convention, no municipality has been willing to share the cost of their development and maintenance. Neither does it appear that

any municipality is really concerned about the kind of landscaping that is taking place, as there appear to be no attempts made to co-ordinate front yard development either by a street to street or neighbourhood to neighbourhood basis. Fortunately, it has become a custom of homeowners in most suburban areas to landscape their front yards with great care and considerable expenditures, but there is also a tendency or desire, on the part of most homeowners, to outdo the neighbours. The usual result is that a typical study unit exhibits just as many front yard landscaping schemes as there are homes without any real benefit to the visual and environmental characteristics. Furthermore, such private attempts at landscaping are governed to a very large extent by a homeowner's attitude and his appreciation of visual beauty as well as by his financial capability for acheiving it. In areas where monies are not readily available for this purpose, or where there is a laissez faire attitude toward beautification of environment, the results can be most undesirable and often become the initial causes of a decline in the environmental qualities of the area.

Another disadvantage with the current front yard or set-back regulations stems from their uniform application throughout a zone, i.e. without respect to the prevailing terrain, the width and function of the roadway, or the micro-climatic conditions referred to by Clive Justice. Such an enforcement of arbitrary regulations, both in the

established gridiron subdivisions and the more contemporary layouts with curved and meandering streets, cannot help but produce hardships and adversities in the siting of buildings. It is bound to create monotonous streetscapes by eliminating the possibilities for the emergence of worthwhile local characteristics.

Summary

In the course of this analysis of current design practices and standards it became apparent that there is no single cause that could rationally be labelled as the primary reason for the adverse environmental conditions in the study unit.

As far as the design and development of the study unit streetscape is concerned, the present local regulations were found not only to dictate, but also to limit its aesthetic and functional qualities. There is also an indefinite number of other factors which are responsible for the existing adversities or conditions; some of these are local in origin, e.g. budgetary limitations and non-progressive leadership, while others, e.g. premature, speculative, or ill-suited subdivision and servicing methods and standards, may have their origins elsewhere, or may have been initiated years ago.

A primary reason for the existence of adverse environmental situations in the study unit was linked directly to the observed vehicular and pedestrian circulation patterns that have been imposed on the existing street layouts and

rights-of-way; most of these were not designed for such purposes and, consequently, cannot perform their assigned duties adequately. The adversities, resulting from this practice, are magnified further by the uniformity and inflexibility of municipal street right-of-way development and servicing methods, which were found to be more concerned with the technical aspects of servicing than with their functional adequacy, suitability, and side effects on the surrounding development.

It was established, both through the literature and field research, that the conventional regulations controlling the development of the streetscape are founded on an arbitrary base, and that they bear little or no relation to the functions of a roadway or its abutting improvements. The literature suggests that the typical suburban streetscape is too excessive in width and that it quite unnecessarily reduces and restricts the useability of abutting properties. Consequently, it would be of both public and private interest to amend some of the conventional regulations in order to facilitate a more functional and aesthetic development of streetscapes as well as of the abutting private properties.

It must be pointed out also that the root of the problem does not appear to lie entirely with the conservatism of the elected and appointed civic officials, but also with the supply and service industry and, above all, with the apathetic population and society. No drastic changes towards a more functional and aesthetically pleasing suburban

streetscape and living environment can be expected until the public at large has been made aware of the present adverse conditions and truly warned of things yet to come. This is a momentous and mammoth task and challenge, but it is also one that appears to be finding more and more supporters in every walk of life.

Footnotes

[1]Royal Bank of Canada Monthly Letter, Our Highways and Our Traffic (Montreal: Royal Bank of Canada, 1965), Volume 46, Number 1, p.2.

[2]See Chapter One, p. 17.

[3]Kevin Lynch, Site Planning (Cambridge: The Massachusetts Institute of Technology Press, 1963), p.47.

[4]Lewis Keeble, Principles and Practice of Town and Country Planning (London: The Estates Gazette, Ltd., 1961), p. 134.

[5]See Introduction, p.1.

[6]Working group, Traffic in Towns: A Study of the Long Term Problems of Traffic in Urban Areas (London: Her Majesty's Stationery Office, 1963), paragraph 468.

[7]National Committee for Traffic Safety, Building Traffic Safety into Residential Developments (Chicago: National Committee for Traffic Safety, 1940), p.1.

[8]Underground: sanitary sewer, storm sewer, (drainage), water main, and gas main; on the surface: roadway and sidewalk (to which could be added services such as street trees and signs, various other types of signs,mail boxes, fire hydrants, fire alarm boxes, litter cans,etc.); and above surface: electricity, telephone, and cablevision lines and street lighting.

[9]Excellent discussion of the servicement question is to be found in the unpublished Master of Arts Thesis by Franklin Arthur Wiles, "Street Use and Servicing Planning: An Investigation of Design Possibilities and Feasibility of Underground Public Utility Structures in Local Residential Streets" (University of British Columbia, Vancouver, 1964).

[10]This practice varies from province to province: for example, the Alberta regulation 361/63 spells out the exact minimum dimensions required for roads in that Province. Government of the Province of Alberta, The Subdivision and Transfer Regulation Pursuant to the Planning Act: 1963, Alberta Regulation 361/63 (Edmonton: L.S. Wall, Printer to the Queen's Most Excellent Majesty, 1963), Part II, Section 25.

[11]Province of British Columbia, Municipal Act (A. Sutton: Printer to the Queen's Most Excellent Majesty in right of the Province of British Columbia, 1964), Part XXI, Section 713 (a).

[12]See Introduction, p.2.

[13]See Chapter One, p.25.

[14]Canadian Good Roads Association, Manual of Geometric Design Standards for Canadian Roads and Streets (Ottawa: Canadian Good Roads Association, 1963), p.iv.

[15]Ibid.

[16]Spacing by the author.

[17]Canadian Good Roads Association, loc. cit.

[18]Ibid., p. 5 and pp. 54-59.

[19]The North Vancouver District Municipality is the only known British Columbia municipality that has made extensive use of the replotting technique for the purpose of improving their arterial and collector road patterns; Snake Hill re-alignment and the design of a completely new 'Cross-town route' are the primary examples of this.

[20]Canadian Good Roads Association, op.cit., p. 54.

[21]National Committee for Traffic Safety, Building Traffic Safety into Residential Developments (Chicago: National Committee for Traffic Safety, 1940).

[22]United States of America.

[23]Op. cit., p. 1.

[24]Op. cit., p. 25.

[25]Adapted for convenience from Canadian Good Roads Association, Manual of Geometric Design Standards for Canadian Good Roads and Streets and from National Committee for Traffic Safety, Building Traffic Safety into Residential Developments.

[26]See Appendix A, page 133.

[27]Community Builders' Council of Urban Land Institute, The Community Builders' Handbook (Washington: Urban Land Institute, 1960), P. 124.

[28]Urban Land Institute, Building Traffic Safety into Residential Developments (Washington: Urban Land Institute News and Trends in City Development, 1961), Volume XX, Number 7, p.5.

[29]Community Builders' Council of Urban Land Institute, loc. cit.

[30]The Corporation of the District of North Vancouver, "Standard Plans and Specifications - Subdivision Services" (manual compiled by the Municipal Engineering Department, North Vancouver, British Columbia, 1963). (Mimeographed)

[31]See Introduction, p. 7.

[32]Province of British Columbia, op. cit., Part XIV, Section 552 (a) and (b).

[33]Province of British Columbia, op. cit., Part XIV, Section 556 (1).

[34]Province of British Columbia, loc. cit.,Part XIV, Section 556 (2).

[35]See Chapter One, p. 16 and 20.

[36]Province of British Columbia, op. cit., Part XXI, Section 702-711.

[37]"More Living Space: Are Building Restrictions Limiting Our Living Space?", Western Homes and Living, Volume XV, Number 9 (September, 1964), p. 17.

[38]H.P. Oberlander and F. Lasserre, Annotated Bibliography: Performance Standards for Space and Site Planning for Residential Development, Division of Building Research, Bibliography #19 (Ottawa: National Research Council, 1961), p. (i).

[39]Ibid., p. (iii).

[40]Garrett Eckbo, Urban Landscape Design (New York, Toronto, London: McGraw-Hill Book Company, 1964), p. 153.

[41]See Chapter One, p. 18.

[42]Garrett Eckbo, op. cit., p. 154.

CHAPTER THREE

RECOMMENDATIONS FOR STUDY UNIT DEVELOPMENT

Objective, Method, and Scope

The objective of this Chapter is to investigate and to present techniques by which local civic authorities could develop the rights-of-way and streetscapes [1] of the study units [2] under their jurisdiction in a functional and aesthetic manner to the benefit of both the individual property owner, i.e. the citizen, and the community at large.

The recommendations have been ranked, or organized, in accordance with their effectiveness in eliminating adversities in a study unit. Thus, those recommendations pertinent to the improvement of a study unit's basic characteristics, e.g. function, are presented first; those dictating its development, e.g. land use controls and regulations, within the framework established by the basic determinants, second; and so down the scale to a category of auxiliaries which help to enhance the image and usage of a study unit, e.g. street furniture. This should not be interpreted to mean that the

employment of these recommendations out-of-sequence, or in a different sequence, would fail to bring about improvements in a study unit. But the degree of betterment, achieved through such unrelated employment of proposed recommendations, would be naturally less rewarding as well as less economical. Indeed, it may even give rise to new and unprecedented adversities.

The recommendations are presented in two parts. Firstly, techniques applicable to fully or partially developed study units, as only remedial action is possible in these, and secondly, those applicable to future and potential study units, where original layout and design is possible. This does not imply, however, that some of the recommendations for one category of study units cannot, or may not, be employed successfully and economically also in the other category.

The scope of recommendations in this Chapter has purposely been limited to a presentation of techniques which can be fitted readily into most existing development by-laws as revisions and additions, and which, therefore, do not require the adoption of wholly new development controls.

Circulation and Traffic Management

It is evident from the literature and field inspections that most established suburban residential areas have reached a state of development which for all practical purposes may be labelled 'completed', i.e. their basic components and characteristics, e.g. housing and street patterns, are well

established, at least for the remainder of the current development cycle. But research showed also that the majority of study units in these areas exhibit several adverse functional and environmental properties, and that most of these adversities stem from ill-suited street layouts which lack the qualities necessary for smooth and conflict free circulation and the maintenance of good environmental characteristics.

> The circulation system is most prone to technological development, and therefore must be most adaptable to future change , . . .[3]

The greatest change in the characteristics of a study unit in modern times was, of course, brought on by the automobile. But the deterioration of conditions in a study unit is largely the result of man's inability to conceive the impact of the car upon the residential environment and streetscape and his reluctance to adopt and to enforce meaningful corrective measures. The literature revealed that the primary emphasis in these situations should be centered upon the reduction of the dominance of the automobile as most of the adverse conditions have resulted from the almost complete lack of control over its movements. So far it has been a common practice to attempt to reduce the possibilities for conflict by providing for the car, and this usually at the expense of the pedestrian and the resident, e.g. wider and better roadways, more curb parking, driveway cuts in sidewalks, and so forth. But these methods alone cannot correct the basic design deficiencies of a layout.[4] Traffic is like water -- always seeking the path of least resistance to reach its destination, and thus many of these remedial

measures have, by removing the obstacles from the path of the car, actually resulted in increased traffic volumes and consequently, increased the adversity of living conditions which once were considered to be poor enough to warrant corrective measures.

Therefore, one of the first and most basic requirements for the upgrading of adverse conditions is, for communities with ill-suited, conventional layouts and traffic patterns, to avoid the continuation of ineffective corrective practices. Instead, they should develop and adopt "functional" circulation and study unit renewal plans.

> . . . (the) elements of the "functional" street plan are: different design standards for streets intended to carry different traffic volumes at different speeds; local streets, designed to serve only the abutting properties, laid out as loops and culs-de-sac; long blocks or perhaps even super-blocks with interior pedestrian movement; a limited number of access points to major streets; and employment of three legged T-intersections, . . . [5]

The principal aim of such plans should be, of course, to divert non-local traffic and its undesirable effects from as many study units as possible; to make them function as true access roads to the abutting properties only and to increase their environmental potential. Redesign of existing, open street networks to layouts with directive and planned vehicular circulation channels will naturally enhance greatly the movement and flow of traffic, although it will also curtail the flexibility of circulation patterns and make traffic movements more sensitive to interruptions at single points on main traffic arteries. But the benefits gained through

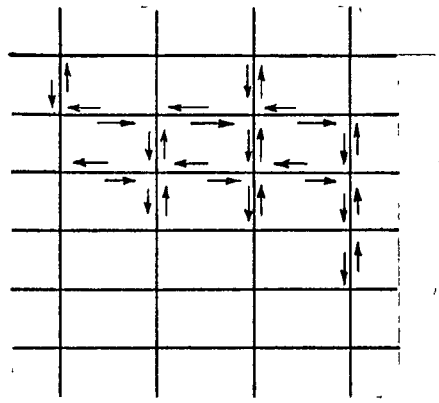
increased efficiencies and safety alone in the movement of traffic are said to outweigh the above mentioned disadvantages of indirectness and dependency.[6,7] The adoption and implementation of circulation plans will also yield numerous other benefits, i.e. they will open the door wide to other, more specialized improvement techniques. Some of these will be, no doubt, of more direct advantage to the community at large than to the individual homeowner in a study unit while others will profit the latter more directly than the community, i.e. all gains will be mutual. For example, implementation of a circulation and study unit renewal scheme will result in considerable savings to a community as it makes it more realistic to construct lighter and more appropriately dimensioned roadways on access streets, less powerful, less expensive but more ornamental street lighting fixtures, and so forth. This, in turn, will augment the environmental potential of a study unit, increase the possibilities for functional and aesthetic streetscape design, and also reduce the homeowner's share of its development costs.

> . . . It is basically a new concept in urban redevelopment. Not only does it offer a method of protecting an older subdivision from traffic hazards and noise, but also from the resulting neighborhood blight, property depreciation, and loss of residential character and attractiveness.[8]

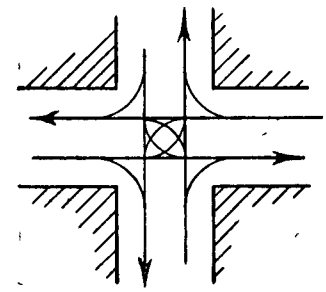
An additional, advantageous feature of this renewal technique is that it does not necessitate the removal or relocation of either the existing overhead or the underground utility lines, as it affects only the usage and development

of a study unit right-of-way and does not necessitate any changes in its dimensions or legal status. The elimination of existing overhead utility lines would, of course, augment greatly the appearance of a study unit streetscape but the high costs involved make this a practical impossibility for a considerable time to come.

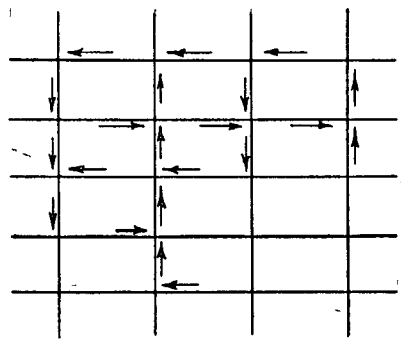
The literature suggested that there are numerous techniques by which improved circulation patterns can be developed and environmental characteristics of a study unit enhanced. The simplest, least expensive but also least effective method is, of course, to control vehicular movements by restrictive traffic regulations, e.g., speed zones, stop and yield signs, and parking prohibitions. But this method is, although necessary as a tool in any scheme, basically negative in its intent, and therefore compatible with neither good traffic nor environmental design. In other words, the employment of restrictive traffic regulations alone will help to eliminate adversities but it does not constitute a true and competent system. A more advanced variant or example of this method is the system of one-way streets where traffic flows are forced to alternate in direction between one street and the next parallel one as shown in Figure Seven, on the following page. This method, widely used in congested downtown areas, reduces the number of conflict points at intersections, but it also increases greatly the carrying capacities of streets and therefore, is not well suited for the betterment of environmental conditions of connection residential access streets in suburbia,



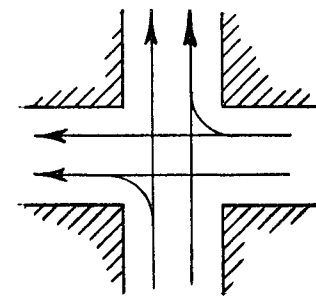
OPEN GRID SYSTEM



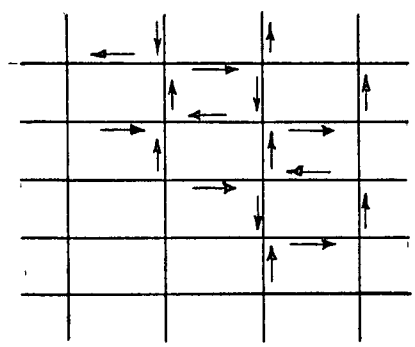
TYPICAL INTERSECTION



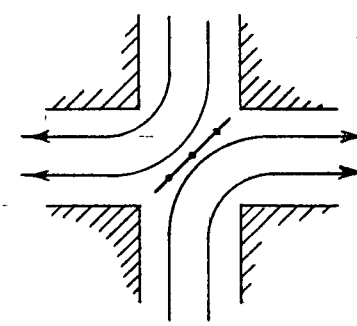
ONEWAY SYSTEM



TYPICAL INTERSECTION



STEADY-FLOW SYSTEM



TYPICAL INTERSECTION

F I G U R E S E V E N

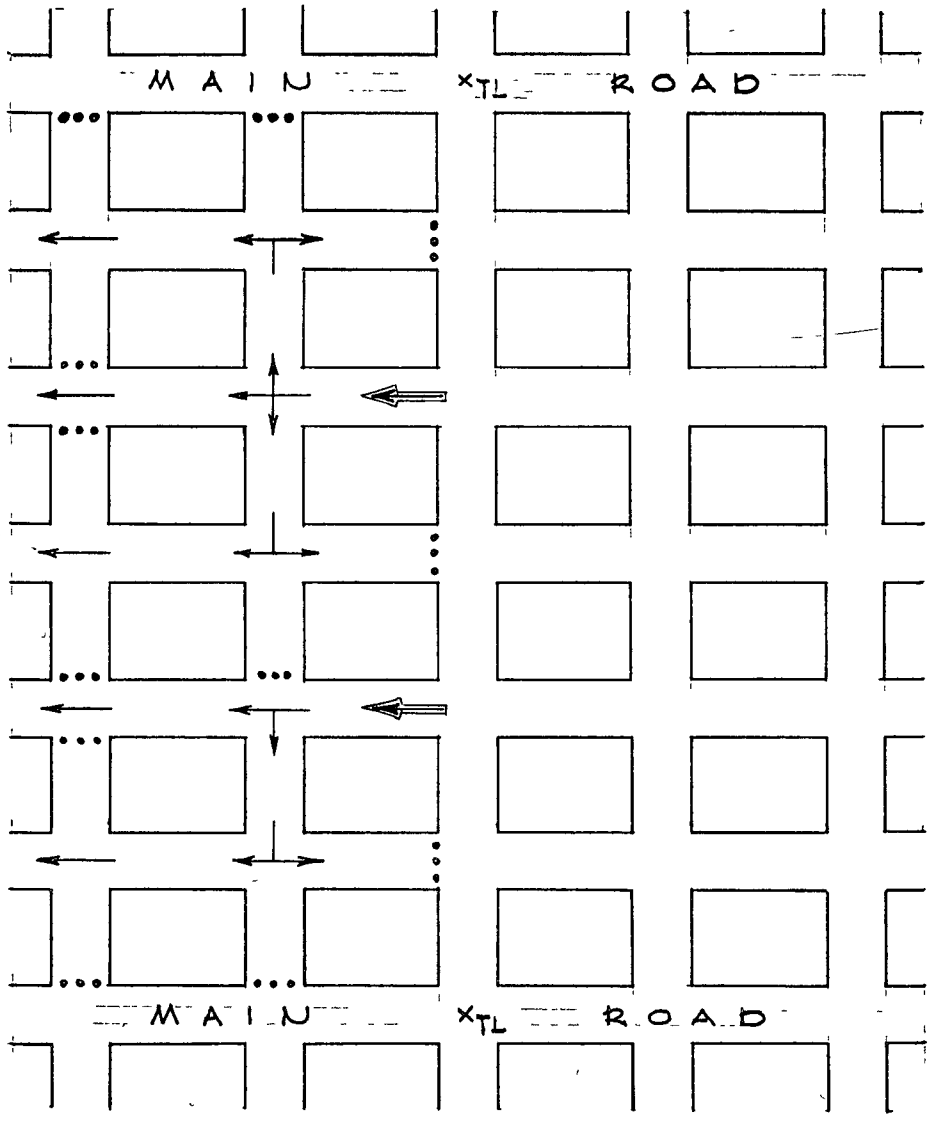
TRAFFIC SYSTEMS

unless changes are contemplated in the dimensions of roadways. An even more extreme example of such one-way systems is the "steady-flow system in which movement is directed clockwise and counterclockwise around adjacent blocks"[9] as also shown in Figure Seven, on the preceding page. This system eliminates all direct crossings of travel paths, forces all flows into a continuous weaving movement and creates exceedingly indirect traffic patterns. A very much advanced version of this system was advocated by Kenzo Tange for the renewal of traffic arteries of Tokyo[10], but there are indications that the employment of this system at a community or neighbourhood scale will not result in any great improvements to the residential environment of a study unit.

Blocked grid layouts are a third possibility and from research it appears that this method offers the most ideal solution for the betterment of existing study unit streetscapes and environments. Lewis Keeble says,

> . . . In the common case where a small-meshed gridiron layout adjoins an arterial, . . . , it should be possible to convert a large proportion of the streets entering it into culs-de-sac by the simple expedient of putting rows of posts across their ends, and thus forcing the traffic to use the remainder, which by traffic lights . . . could be adequately controlled. . . .[11]

The technique described by Lewis Keeble and shown in Figure Eight, on the following page, demonstrates the principles of this third possibility as well as its almost unbelievable simplicity and obvious inexpensiveness. The barrier technique itself, of course, cannot be recommended



... ROAD STOPPED WITH POSTS, x_{TL} TRAFFIC LIGHT

BLOCKED GRID OPEN GRID

F I G U R E E I G H T

PRINCIPLES OF 'BLOCKED GRID'[12]

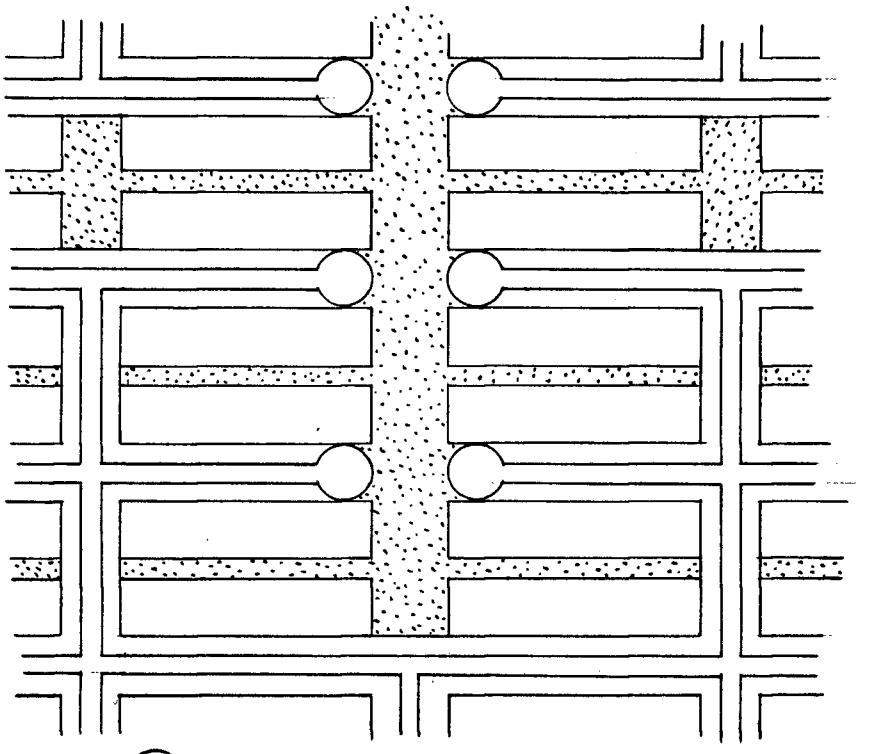
seriously, except on temporary, trial, or emergency basis, as it is bound to be both visually and psychologically objectionable, and this may even result in the defeat of an otherwise worthwhile scheme.

Carl Troedsson has developed the blocked grid principle considerably further. His proposal envisages a grid neighbourhood with completely separate pedestrian and vehicular circulation systems as shown in Figure Nine, on the following page. He advocates that

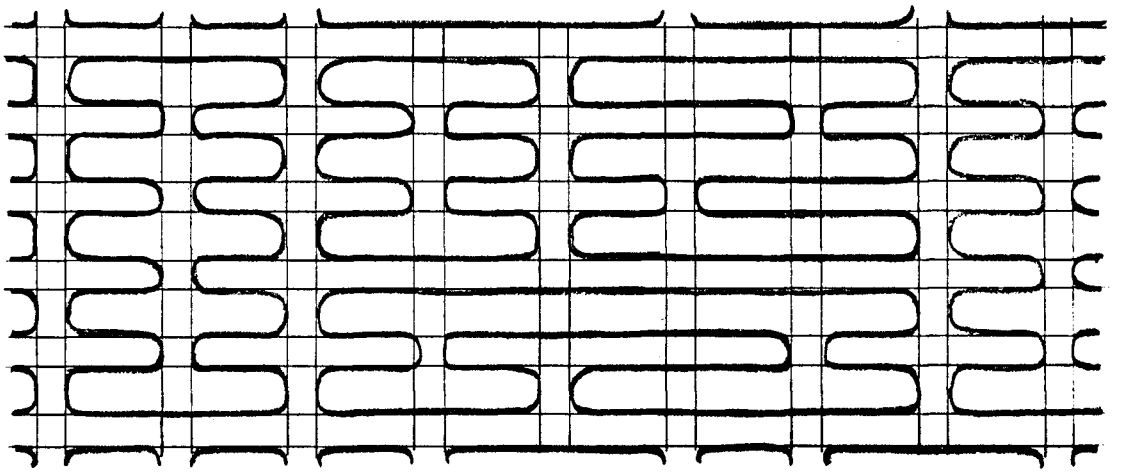
> . . . the two separate street systems clearly delegate rights-of-way for pedestrians and motorists alike, . . . The pedestrian system will provide safety for children, adults, and oldsters. The automobile streets will provide appropriate and exclusive facilities for the driver. . . .
>
> . . . . . .
>
> . . . In the present layout of typical residential district, over 30 per cent of the total area serves the driver, and only 3.6 per cent the pedestrian. . . . the automobile activities will be grouped together, occupying about 26 per cent, while the area which is safe for and devoted to pedestrians will be increased to 31 per cent. [13]

There is much merit in this proposal of interlocking circulatory systems. The renewed residential environment would have most of the positive characteristics of the applauded Radburn plan, although in a considerably more regimented form due to its existing determinants.

It is most unlikely, however, that this sophisticated system would obtain the support and acceptance necessary for application in practice, as it would require expropriation of private land (where there are no public lanes through blocks)



INTERLOCKING CIRCULATION SYSTEMS - ADAPTED FROM C.B. TROEDSSON.



POSSIBLE ALTERNATIVES

F I G U R E N I N E

INTERLOCKING CIRCULATION SYSTEMS[14]

MODIFIED GRID LAYOUT

for the pedestrian circulation system, eliminate private backyards as well as the accepted, traditional differentiation between the front and rear facades of dwellings and, above all, increase the maintenance costs of a community's circulation arteries through the introduction of the additional pedestrian system. A further objection to the proposal, as presented by Troedson, arises from the strictness with which he adheres to the conversion of open grid streets into a super-block of culs-de-sac, with no less than eight to ten standard length culs-de-sac forming a super-cul-de-sac of about 300 homes. Other authoritative sources appear to agree with his proposal in principle but recommend the usage of both culs-de-sac and loop streets for access study units.

> The cul-de-sac or dead-end street has the advantage of preventing through traffic movement. . . .
>
> . . . . . .
>
> The "loop" street is preferable to the cul-de-sac as it provides easy circulation which is desirable for deliveries, fire and police protection, and if well designed, is effective in discouraging fast or through traffic. [15]

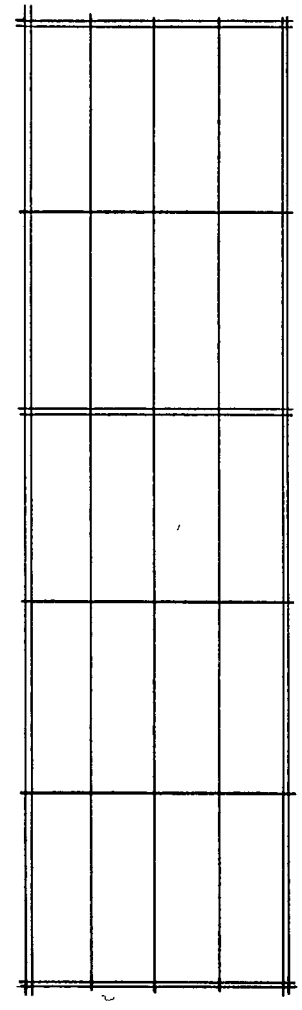
It appears, therefore, that the successful circulation and study unit renewal plan should employ the principles of blocked grid scheme advanced by both Keeble and Troedsson, but for practicability, and public acceptance and endorsement should be neither too simple nor too rigid and radical. Harold Marks recommends the employment of the following design elements:

> 1. Limited access design, preferably limited to quarter-mile access points, . . . to provide maximum safety.
>
> 2. Backup, side-on or cul-de-sac treatment is generally preferable to a service road contiguous to major highways.
>
> 3. Continuous through-streets extending from one major street to another should be avoided.
>
> 4. Collector streets are satisfactory when there are no continuous cross streets and if they exit into only one major street.
>
> 5. Four-legged intersections should be used infrequently, although they are not objectionable where non-continuous access streets join the collector street.
>
> 6. T-type intersections should be used more frequently.
>
> 7. Such design features as multi-legged intersections with more than four legs, acute angle and Y-type intersections, and jog intersections should be avoided.[16]

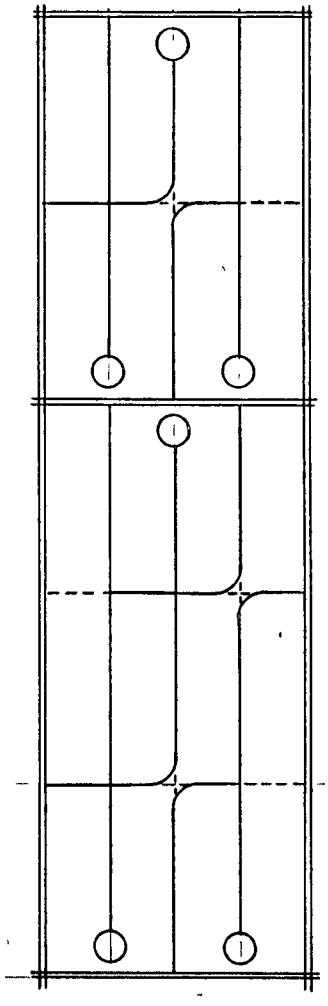
The Urban Land Institute recommends for safe residential design:

> . . . the cul-de-sac or no-outlet lane, and the loop street which has (1) a short run, (2) pavement pumps where needed to tame cars, (3) a paved width of only two traffic lanes, (4) an adequate turnaround if a cul-de-sac, and (5) an adequate number of car parking places to keep the two traffic lanes clear of parked cars at all times. Parking for occupants' cars should be in assured on-lot facilities to the extent possible; the balance may be in car courts or marginal bays and, if necessary, extra parking lanes. . . .[17]

Figure Ten, on the following page, shows a hypothetical gridiron layout and one possible renewal solution of its traffic arteries. Another example of a possible renewal in a partially developed suburban subdivision of difficult terrain is to be found in Appendix 'B'.



GRIDIRON



LIMITED ACCESS

F I G U R E T E N

MODIFIED GRID[18]

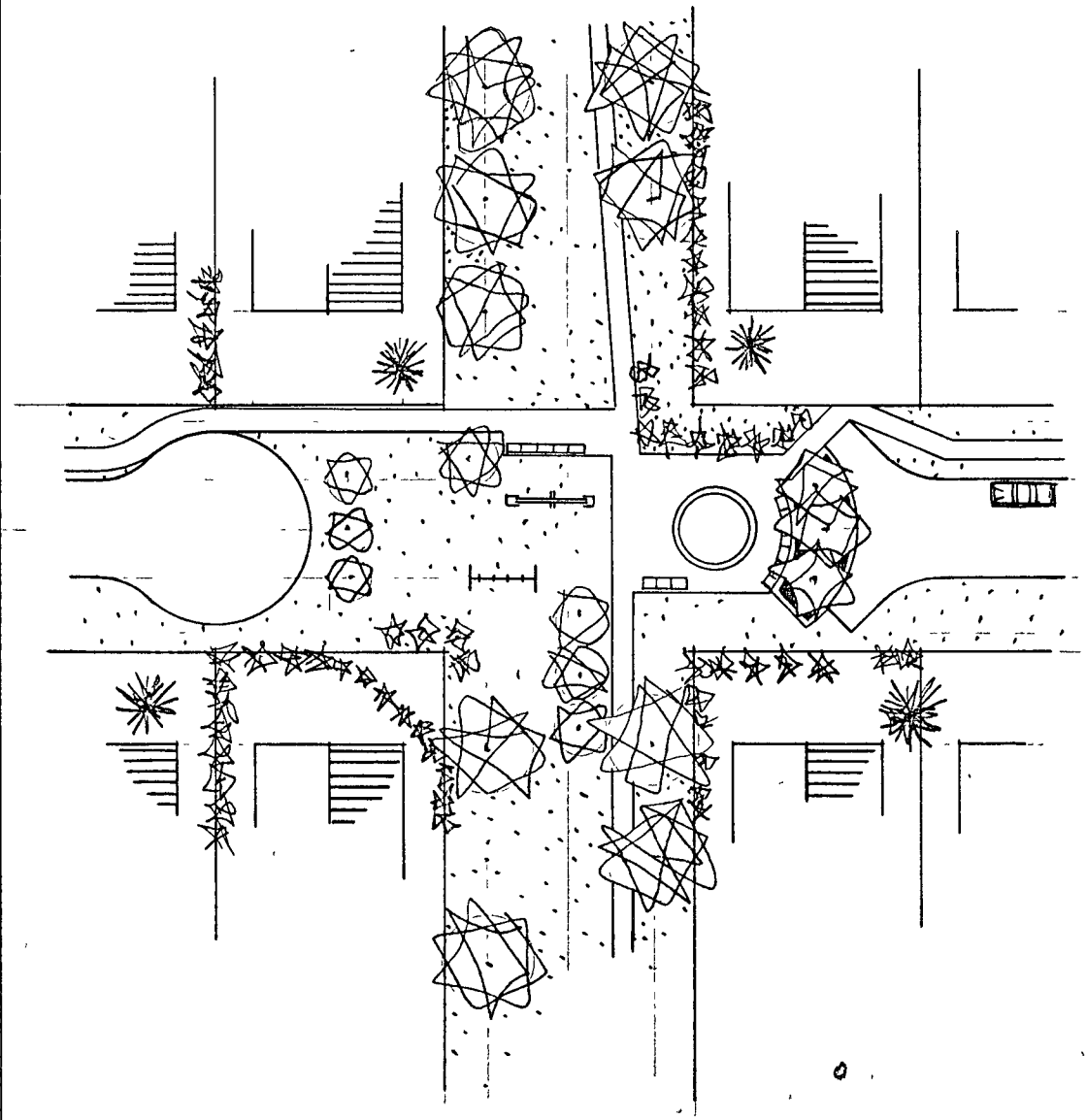
Benefits to be gained from such a renewal scheme by a motorist would naturally depend upon the size and refinement of the scheme — the larger and more thorough the scheme is the more will it help drivers in their travels. It must be recommended that such a scheme have its roadways designed and constructed in accordance with the analysed and calculated needs of each street, i.e. the arterial street should have the widest pavement and the loop street and cul-de-sac the narrowest. This would tell a driver at a glance what road system he is on, what hazards he can expect, and what his safe and proper speed should be. To be fully advantageous such a hierarchy of neighbourhood streets needs naturally to be a functional part of both the municipal and the inter-municipal road networks. If it is designed and constructed in accordance with the predominant desire lines and volumes of traffic, it will make the driving more economical, safer, and more enjoyable.

The pedestrian and resident will naturally also benefit from such channeling of traffic. To the resident it means simply a reduction in the number of adversities that used to affect his private environment, while the pedestrian will now have fewer chances for conflict with the car. The scheme will also allow the creation of a pedestrian circulation network which will be partially divorced from that of the vehicular and, due to the reduced volumes of traffic on most local streets, there will be better opportunities for the improvement of his environment through more suitable streetscape design.

It is common knowledge that most existing gridiron residential subdivisions are lacking in parks and open public spaces. Consequently, children are confined to their own or friends' backyards but more often than not they play in streets, where they are a hazard to traffic and also expose themselves to danger and possible injury from traffic. The blocked grid renewal scheme, however, makes it possible for a community to establish a network of amenity parks and tot-lots as a by-product, simply by turning the blocked-off street ends and flanking streets into public greens. This will, no doubt, help to retard "neighborhood blight, property depreciation, and loss of residential character and attractiveness," [19] in older subdivisions.

A hypothetical layout of such a "by-product" park and tot-lot is shown in Figure Eleven, on the following page.

For undeveloped areas it is, of course, feasible to employ all or any of the car taming techniques described for the improvement of study unit environments in established residential areas. There is only one additional observation that needs to be made: namely, that for optimum residential environment, circulation and the economy of a project the lay-out should recognize and acknowledge the natural features of the project area and impose a street pattern accordingly. The pattern should be a hierarchical circulation system of varying rights-of-way and pavement widths so as to accommodate and 'tame' the automobile in accordance with the predicted and



F I G U R E E L E V E N

'BY-PRODUCT' PARK AND TOT-LOT

calculated volumes and desire lines of the future traffic -- originating both from within the project itself and from future developments beyond.

Zoning

Research indicated that although municipal zoning regulations do not zone, or regulate the usage of public street rights-of-way they still have a definite bearing on the design and the emerging environmental properties of study units. They establish the basic characteristics of a study unit streetscape by dictating the kind and type of usage permitted alongside it, e.g. residential, single-family dwellings; they define the physical limits of its effective streetscape in absolute measurements of distance; and they control the usage and improvement of those portions of its streetscape which lie beyond the boundaries of its dedicated street right-of-way, namely the front yards of abutting, private properties. The literature as well as investigations of current zoning regulations revealed that a major disadvantage to streetscape and environmental design arises from both the arbitrary nature of these controls and from their inflexible application in a zone designated for similar land use.

The factors which should determine the siting and spacing of buildings and other improvements on the abutting properties, i.e. establish the required set-backs and yards, were

found not to be properly, or scientifically related to community objectives regarding fire, daylight, air, noise, privacy, view, traffic and outdoor space. Hence their arbitrary nature. A concept of regulations based on a system of performance standards does undoubtedly hold the greatest promise for future developments and the eventual abolishment of the present, arbitrary regulations. The literature indicated, however, that it is difficult to develop a system of such an intent and calibre until techniques are perfected for the measurement and evaluation of each of the previously mentioned factors in siting a given building on a certain lot. Unfortunately, however, such a system appears to hold little in store for areas with well established housing, i.e. the existing suburbs, which do exhibit a number of environmental shortcomings, but which still are, because of the current development controls, considerably safer, wealthier and more pleasant places for living than were the residential areas of half a century ago.

This study is concerned only with those items of zoning controls that define the dimensions of front yards and regulate the usage and improvement of these yards. The literature revealed that the required set-backs are excessive and "sterilize . . . land that some family should be allowed to enjoy."[20] Inspections and study of established residential areas indicated that, in most cases, the study unit has reached the maximum refinements and development possible

under the present zoning controls. But it showed also that the environmental conditions in the average study units are often far from the ideal and usually in need of some remedial action. Consequently, it should be the objective of a municipality to initiate corrective measures. Research showed that the environmental conditions of both the private dwellings and the study unit could be greatly enhanced if the owners of the abutting properties were permitted to use their front yards, or even portions of these yards, for the purpose of privacy and meaningful enclosure. This, in turn, would effectively reduce the excessive width of a streetscape to one more in scale with the abutting improvements, and allow for its development in accordance with its position and function within a hierarchical system of streets.

An investigation of the function of front yards revealed that their primary purpose has been to ensure daylight to building fronts, to prevent the spread of fire, to reduce adversities arising from uncontrolled and excessive traffic and to allow for the possible future widening of the roadway. Five, four, or even three decades ago these may have been valid and convincing arguments for the establishment of excessive set-back requirements, and, as was noted previously, resulted in an improvement of conditions. But in to-day's technological world of improved construction materials and practices, and particularly in suburban communities with planned hierarchical street systems, improved servicing, better fire fighting equipment, smoother roadway surfaces and more silent

automobiles, such excessive requirements do nothing but restrain the possibilities for functional, contemporary streetscape and environmental design.

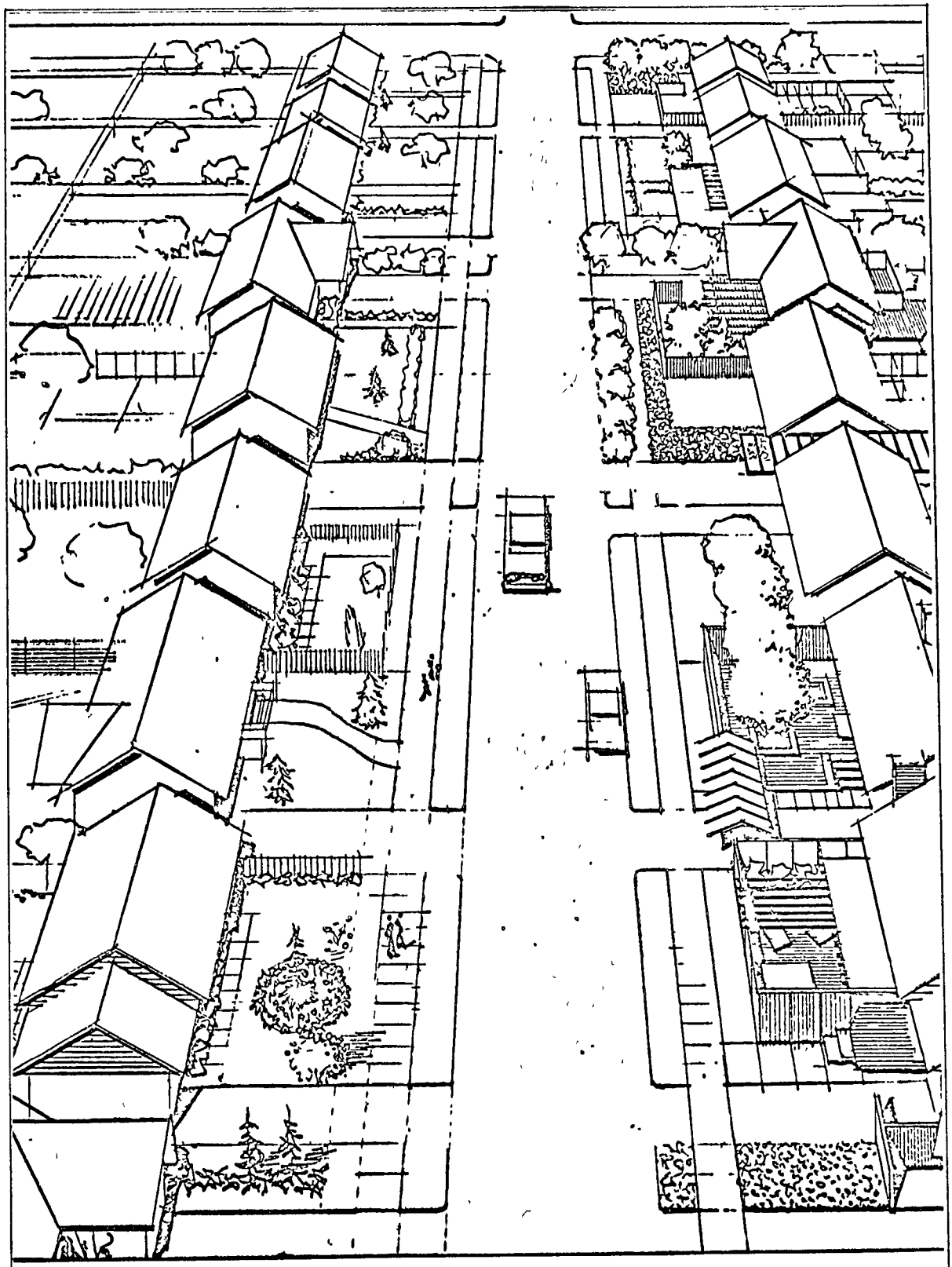
Figures Twelve and Thirteen, on the following pages, show an architect's conception of what relaxed front yard development regulations can do to enhance living environment and streetscape design in any existing study unit.

The degree of relaxation to be permitted and amendements to be instituted for the improvement of environmental conditions and streetscape design in an existing study unit must of necessity still remain rather arbitrary -- at least until techniques for scientific establishment of functionally adequate set-backs and controls in a residential study unit are perfected.

> The most evident weakness of performance standards at present seems to lie in the matter of reliable and detailed scientific measurements of certain technical aspects of space use. The natural sciences will have to provide . . . simple techniques for measuring noise, dust, glare, wind, exposure, etc. The social sciences will have to develop meaningful techniques of measuring and describing such concepts as privacy, intimate views, sense of enclosure, before performance standards for residential areas can become effective. [21]

Improved technical developments in the construction industry and in suburbia in general, however,

> . . . lead to the conclusion that there is no technical or functional necessity for a house to be of any single shape or location on a lot. Therefore any control which is technically unnecessary constitutes a deprivation of private right and must be very carefully scrutinized for compelling reasons of public welfare. [22]



Conventional Proposed

FIGURE TWELVE

ARCHITECT'S CONCEPTION OF STREETSCAPE[23]

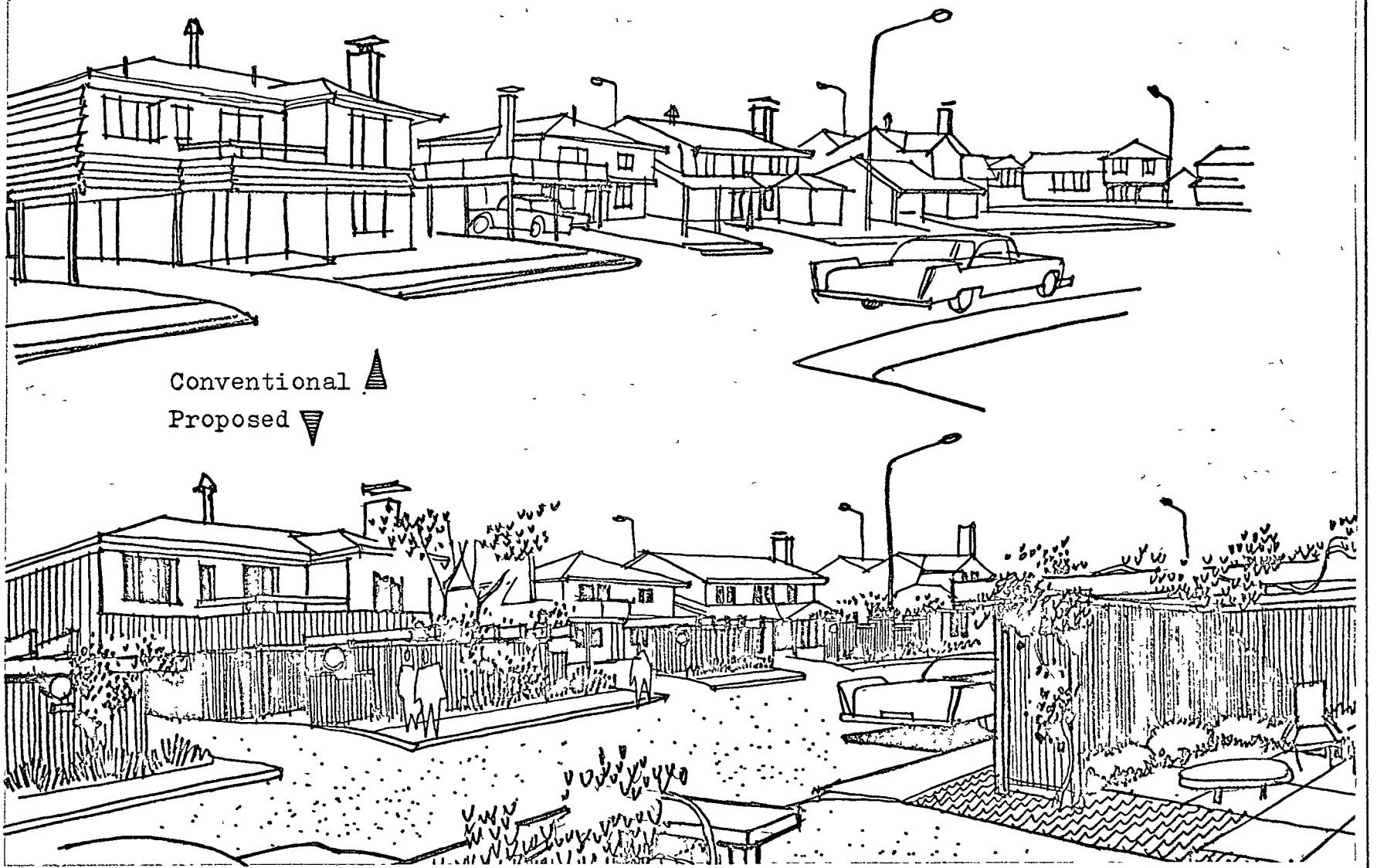
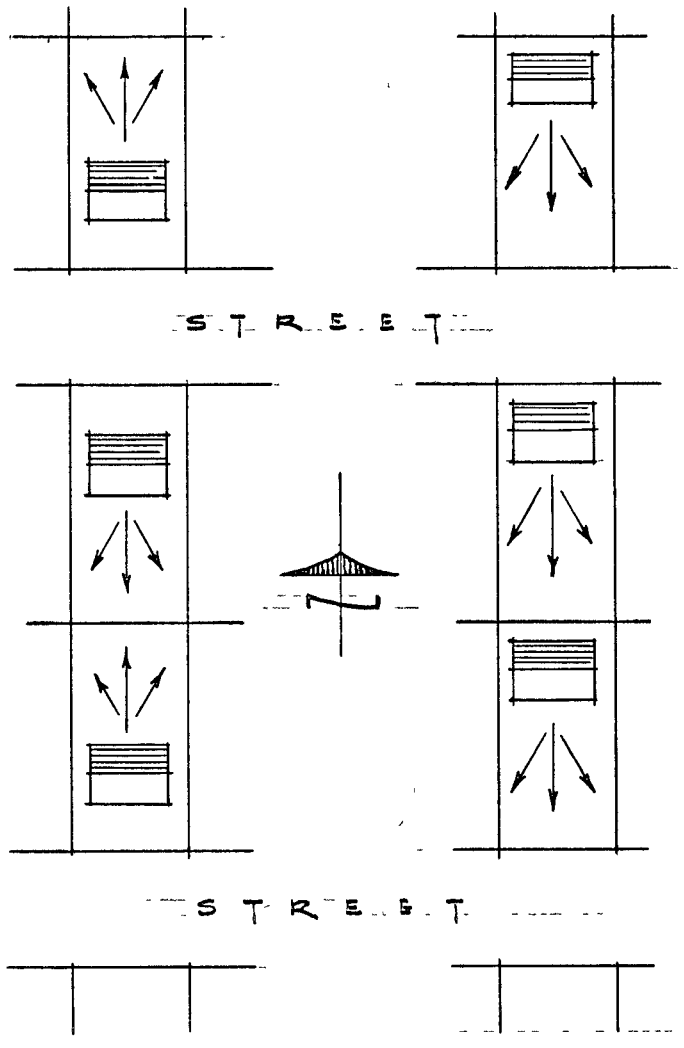


FIGURE THIRTEEN ARCHITECT'S CONCEPTION OF FRONT YARDS [24]

In an existing study unit the opportunities for initial grouping of principal buildings is, of course, past. But a second, although less effective, chance for this is now presented through the possibility of relaxing front yard setback regulations and development prohibitions. As "The convenience and attractiveness of each house is largely dependent upon the design of the group as a whole."[25], the degree of relaxation to be permitted must be carefully weighed and the criteria for this determined on a study unit basis — not on an individual lot basis. All changes and all plans for renewal of study unit streetscapes, i.e. grouping of additional improvements, must be based on thorough studies of each unit — its function within the street system of a neighbourhood or community, its orientation, topography, its present degree and nature of development, and so forth. For example, it may be found advantageous to recommend that a more liberal set of regulations be applied to those front yards which face the mid-day or afternoon sun, than is applied to those which face the morning sun or completely away from the sun, in order to permit maximum possible use of the sunny yard. And similarly, properties with sunny back yards should be permitted a less restricted usage of these yards. Such differentiation is neither discriminatory nor unfair. It is both functional and practical, as can be seen from the diagrammatic illustration in Figure Fourteen, on the following page.

Local study unit characteristics and design determinants, like the described example of orientation to the sun, cannot



CURRENT PROPOSED

ARROWS INDICATE ORIENTATION OF HOUSES AND ACTIVITIES.

FIGURE FOURTEEN

PROPOSED ARRANGEMENT OF 'ACTIVE' YARDS

be recognized through current regulatory practices as the Municipal Act requires that all similar uses in a zone be controlled by identical regulations.[26] The traditional practice has been to divide a community into two or three large residential single-family zones on the basis of minimum permissible lot size.

> It is possible, and not uncommon, for a whole township to be reduced to little pieces of identical dimensions; on each plot only one sort and size of house can be built.[27]

Consequently, to improve the existing environmental conditions and appearances of study unit streetscapes, it will be necessary to amend such blanket policies and controls. The basic aim behind such revisions or changes should be, of course, to devise techniques through which more attention can be given to local peculiarities and needs. It appears, that under the current municipal authority, the only method by which more tailor-made zoning regulations can be adopted is through a refinement of the traditional area zoning controls. This will necessitate a division of current large zones of uniform regulations into smaller and more specific zones.

This technique would be perfectly legal as the Municipal Act does not specify the areal extents of zones; they may be relatively small or cover large and continuous parts of a community, as long as consideration is given to:

> (a) The promotion of health, safety, convenience, and welfare of the public;
>
> (b) The prevention of the overcrowding of land, and the preservation of the amenities peculiar to any zone:

(c) The securing of adequate light, air, and access:

(d) The value of the land and the nature of its present and prospective use and occupancy:

(e) The character of each zone, the character of the buildings already erected, and the peculiar suitability of the zone for particular uses:

(f) The conservation of property values.[28]

The creation of a number of smaller zones in recognition to ". . . amenities peculiar to any zone . . ."[29] would permit the application of additional or amended regulations appropriate to any given zone, which may contain any number of existing study units, or even only portions of study units. For example, the previously described active yard concept could be implemented through an application of tailor-made amendments to those set-back and development regulations which currently control the development of properties on either side of an east-west study unit.

Such a proposal for refinement of existing zoning controls will, undoubtedly, meet considerable opposition from most civic authorities as it would make their administrative chores more intricate. It will not increase or complicate, however, the administration of a zoning by-law, but like any refinement or departure from the traditional, will require more meticulous application.

In the still virgin or undeveloped areas of suburban communities the possibilities for the creation of more appropriate study unit environments are, naturally, more plentiful. A

relevant criterion for the realization of superior streetscapes in future study units is the employment of rational development regulations which recognize contemporary needs and desires. While research indicated that in established study units only limited revision and up-dating of zoning regulations was practical, it is obvious that in virgin areas the employment of completely revised or even new sets of zoning regulations is perfectly feasible. And for the above mentioned purpose, also imperative. This necessitates, however, that, in communities where undeveloped land of any consequence remains, the zoning by-laws should designate such areas as distinct and separate districts or zones from those already developed. The prime purpose of this technique is, of course, to free virgin areas from the shackles of conventional and ill-suited zoning regulations, but also to prevent their premature subdivision and development which may greatly impede the implementation of a desired, orderly and economic development plan.

Once an outline development plan has been established and adopted it can be implemented either by full scale re-zoning for relatively unconctrolled and non-directed development, or by partial re-designation of the "holding zone" [30] for staged and controlled growth. In either case, however, it is essential, for the achieving of optimum results in future study units, to divide the virgin area into a number of smaller, specific zones in a manner similar to the technique advanced for re-zoning of established residential areas.

The regulations of each of these zones must naturally reflect the topographic, climatic and other dictums and amenities in their given areas, as well as the function of their study unit streets in the overall circulation system. And, in the drafting of minimum set-back requirements and improvement controls, consideration must be given also to the improved construction materials and techniques of to-day, the higher degree of servicing, and so forth.

Investigation led to the conclusion that for the purpose of augmenting study unit streetscape design and quality of residential environment in yet to be developed suburban areas the set-back regulations and improvement controls must be tailor-made as far as possible. Research showed also that there is no technical or functional need for excessive front yards and absolute prohibition of siting improvements in these yards. In general, it must be advanced that the principal aims behind these regulations need not differ greatly from those advanced for the improvement of conditions in established study units.

Subdivision

In fully established single-family residential areas the employment of more imaginative or more functional subdivision techniques and regulations is out of the question as the present development 'pattern' is permanently fixed, at least as far as the current cycle of development is concerned.

In less fully established areas where some larger parcels, or a larger number of smaller undeveloped parcels of land remain, it is still possible to impose a more contemporary and more functional subdivision layout which would recognize the natural characteristics, the circulation desire lines, etc. of the area better than, perhaps, would the continued implementation of the conventional layout. Such revamping of ill-suited layouts is possible through the employment of delegated replotting powers.[31] provided for this purpose by the Municipal Act.[32] A further improvement of streetscape and residential environment would be possible in such an area if the undeveloped pocket of land was designated as a zone of its own and its development controlled by a set of tailor-made zoning and subdivision regulations.[33]

The opportunities for the creation of functional and contemporary study units through the employment of superior subdivision designs are naturally greatest in the yet to be developed areas of suburban communities. But there are also a number of obstacles which must be overcome before new development concepts and plans can be implemented. One such obstacle in the way of innovations is the conventional subdivision by-law with its clauses of standard and almost inflexible requirements regarding rights-of-way dimensions, lot shapes, frontages and perpendicular, jog-less lot lines, etc.

> Like all 'standards', subdivision design standards have not only prevented very bad design but have discouraged very good design and new ideas.[34]

The literature indicates that for good environmental results in future study units a subdivision layout should always be in agreement with the dictums of topography and other peculiarities of a given site or area; lots should be fitted and individually designed -- not imposed, into the landscape, and streets of appropriately dimensioned rights-of-way (in accordance with their function and design speed[35]) should be used to provide physical access to these lots and should not be used simply to create blocks of identically dimensioned and shaped lots.

> There should be variations in lot sizes which are determined by topography, location, and cost of production, and not by uniform controls. . .
> . . . . . .
> If more economic use of land. . . (is) to be gained, if the deadly uniformity of appearance of new subdivisions is to be overcome and better places in which to live created . . . much of the remedy lies in adapting new techniques to old standards.[36]

It may be concluded from the preceding then, that as long as rigid and arbitrary regulations determine subdivision and lotting, it will be difficult, if not impossible, to secure the advantages of new techniques and the potentialities of a given site. Consequently, it is essential to adopt new regulations. Such new regulations need to be co-ordinated, of course, with the concepts and requirements of overall development plans as well as with corresponding zoning regulations. Proper co-ordination requires, first of all, that the overall plans establish in a schematic manner the uses permitted, the circulation systems required, and so forth; secondly, that zoning by-laws designate zones and establish general

regulations, e.g. single-family, 7,200 square feet minimum in area; thirdly, that sub-division by-laws establish suitable regulations for the lotting of each zone, e.g. required lot frontages, depths, etc. (preferably a range of these) or a plan; and that finally, the zoning by-laws establish the more specific, tailor-made controls for development or improvement of lots in each of the zones. In other words, the regulations should be "custom made" to suit given circumstances and conditions and be based on thorough studies for good results.

As far as the development of a given study unit is concerned, it is essential that, on subdivision of undeveloped areas, the implementation of the hierarchical street system be facilitated through the regulations of subdivision by-laws, i.e. the future study unit rights-of-way dimensions should be correlated with the requirements of overall circulation plans.

> The . . . type, and size . . . should be determined by the need and number of houses served, rather than have . . . (streets) uniform throughout a subdivision. [37]

Thus, in a residential single-family area, the local access streets of low traffic generating and carrying capacities should have the narrowest permitted rights-of-way. Indeed, even within this category of streets there should be a provision made for at least two widths of rights-of-way; a narrow one for short culs-de-sac and one-way loop streets and a slightly wider one for two-way loop and other connecting streets. Policies regarding on-street parking and pedestrian circulation channels have, naturally, a decisive influence on

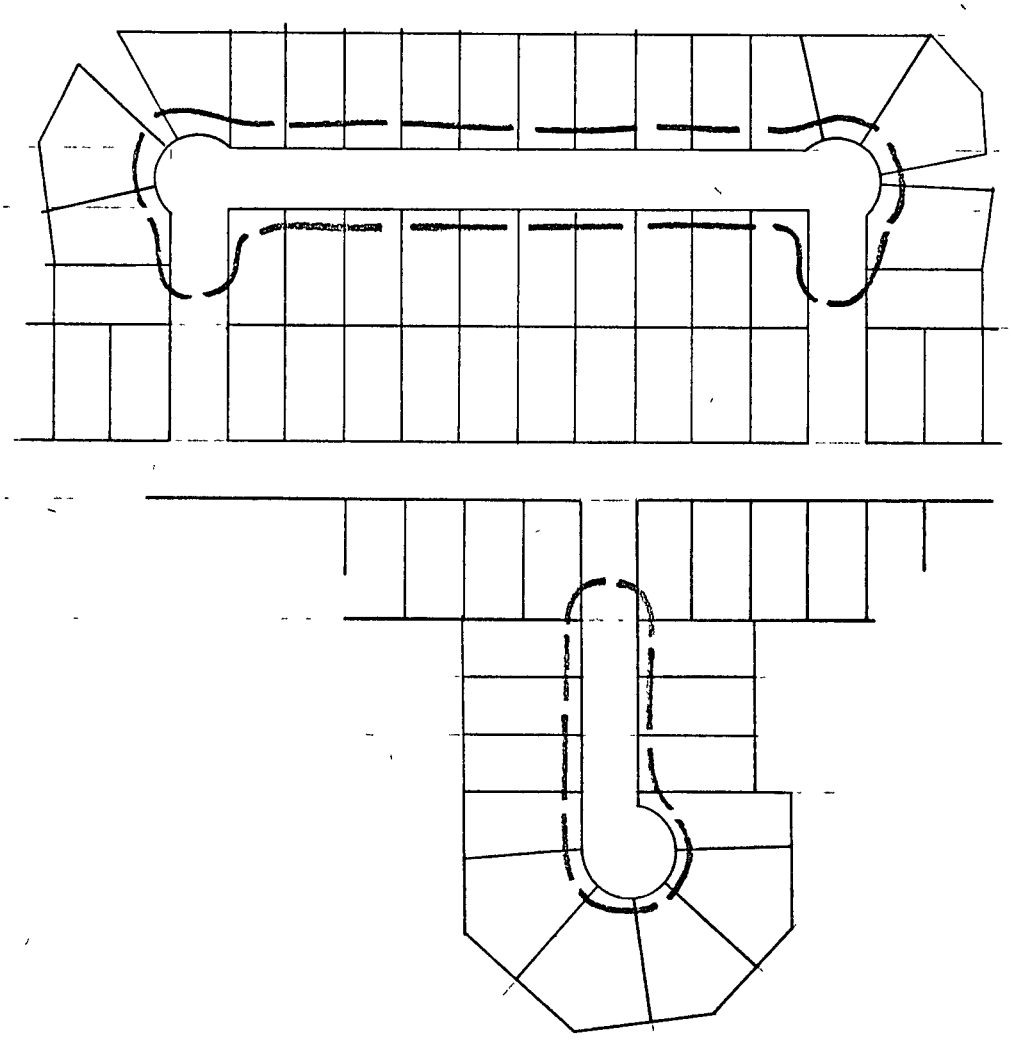
future street rights-of-way dimensions, and must be taken into consideration.

From streetscape design and residential environment points of view, a narrow access right-of-way will provide for better grouping of houses in a study unit, and particularly so in a predominately one- and two-storey suburban setting, as it will help to bring the opposite house fronts into a closer, more intimate and effective relationship with one another.[38]

From the development economics points of view, considerable savings are possible, both to the community and the developer, through the usage of varied rights-of-way widths, as less land is needed to be dedicated for roads and the "savings" can be put into tax and revenue producing use.[39]

The literature offers an almost unlimited number of layouts for residential single-family subdivision. All of these have their own merits; some are excellent from the traffic safety point of view, some offer good development economies, others admirable housing groups, privacy, open space, or any combination of these. They all have one thing in common, however, in that they have been designed to suit a particular situation. These layouts should never be copied in their entirety, but their principles and techniques can be adapted to any given situation and, usually, produce desired or anticipated results.

Figure Fifteen, on the following page, shows two study units which were found to hold the greatest promise for good streetscape and environmental design.



F I G U R E F I F T E E N

LAYOUTS FOR OPTIMUM STUDY UNITS

Development

The previously discussed and described development controls establish the basic characteristics of study units. The development or improvement of these study units is commonly the subject of specific street by-laws and engineering specifications. As "Most effective results can be obtained only through original layout and design." [41], and not through an application of uniform standards, it is essential that the elected municipal officials direct their technical advisors and administrators to work out comprehensive, co-ordinated development plans for each study unit. Co-ordination of the installation of utilities, street improvements and other items of street furniture within the boundaries of a study unit right-of-way, would not only result in improved development economies, but also in superior study unit streetscapes, both environmentally and visually.

Of particular importance to a study unit streetscape is the width of its roadway. It was noted that there is a common tendency among municipal engineers to overdesign roadways, with the result that roadways have become the dominating features in suburban study units. To correct this adverse situation it is essential that pavement widths be related to the calculated circulatory requirements of study units. For example, the roadway of a cul-de-sac study unit should have its width determined in accordance with the traffic generating capacity of the homes in the study unit, but in loop and linking study units consideration must be given also to effects

of traffic from their encatchment areas — all, of course, in accordance with their appropriate design speeds.[41]

To enhance the environmental qualities of study units, particularly in the still undeveloped, virgin areas of communities, it would be essential that municipalities and developers alike refrain from the conventional practice of complete clearing. Instead, a municipality should employ and advocate selective clearing techniques in areas of forested land and prohibit cutting of healthy trees in sparsely wooded areas. Such practice will require, undoubtedly, more careful design of services in a study unit, but it will yield numerous benefits. It will, for example, reduce the need for ornamental shade trees within the rights-of-way, reducing public boulevard tree maintenance programmes and costs. To home-owners, it will give better starting points for their ventures into landscaping. In hilly and precipitous areas it will help to retard run-offs, minimizing the need for extensive drainage systems, retaining walls, and so forth. But above all, retained trees will help to give each improvement a setting and character of its own, and the total effect of native trees kept will help to determine the environmental quality, image and reputation of a study unit, a development and a community.

In existing and future study units, which lack large scale natural vegetation, the question of introduction of ornamental boulevard trees will arise sooner or later, as

> . . . trees are the one addition large enough in scale to complement residential architecture and compete with our horrible method of distributing power and telephone services, power poles . . .[42]

Past practice of planting trees of one or two species in straight lines along the boulevards in a study unit has been an improvement of the environment, but it has also "compounded the error of spatial monotony."[43]

Therefore, it should be the objective of municipal boulevard tree planting programmes to provide for contrast, colour, shape, mass, texture, and so forth, through an imaginative grouping of trees.

Visual characteristics, image and identity of study units and developments can be enhanced to no small extent by dividing a community into specific design areas, each of which would have its own design criteria. The simplest and cheapest technique for this is colour-coding of all items of street furniture in a design area with a selected area colour. Further distinction between design areas is possible through the use of different types of pavements on roadways, different textures and colours on sidewalks, different designs of street lighting, etc.

Such a division of a community into design areas may be made on a fairly arbitrary basis, but wherever possible, an attempt should be made not to split natural and physical units.

Summary

The objective of this chapter is to present recommendations which would enable a community to develop its street rights-of-way in a functional and aesthetic manner. The recommendations are presented in the order of their assessed effectiveness and value to the improvement of environmental conditions in a study unit. The scope of these recommendations has purposely been limited to a presentation of techniques which can be readily fitted into most existing development by-laws as revisions and additions and which do not require their complete replacement.

Research revealed that for best possible improvement of study units, it is necessary to differentiate between street rights-of-way which are developed and those yet to be developed, as existing study units permit the employment of remedial techniques only, in contrast to future study units where original layout and design is possible.

It was established that to enhance environmental conditions in existing study units, it would be essential, first of all, to tame the automobile. The literature revealed that most of the current corrective practices to this end are rather palliative in their effectiveness and that for more trenchant results, both in the taming of the automobile and improving study unit environments, it is necessary to develop and to implement "functional" circulation and comprehensive study unit renewal plans. The implementation of such plans was found to

yield also numerous other benefits as by-products, e.g. decreased development costs and increased possibilities for the employment of other, more specialized improvement techniques. The greatest attractiveness of these plans lies, undoubtedly, in the fact that they deal only with the usage of a study unit's right-of-way and that they do not necessitate any changes in its legal status or dimensions.

Research revealed that there are numerous techniques by which desired circulation patterns can be achieved. It appears that the blocked grid concept is most suitable for employment in existing suburbia, and the literature suggests that for practicability, and public acceptance and endorsement it should be neither too simple nor too radical. In the yet to be developed areas the choice of car taming techniques is, of course, less limited as original layout and design is possible. The literature suggests that for optimum study unit environment and traffic efficiency in these areas the circulation system should be a hierarchical one, recognize the primary desire lines and volumes of predicted future traffic and take into account the configuration, if any, of the given terrain.

Research indicates that zoning has a bearing on the design of a study unit's streetscape in so far as it dictates the kind and type of usage permitted alongside it, defines its physical limits and controls the usage and improvement of front yards. It became apparent that as zoning regulations are arbitrary and many of their requirements quite unnecessary,

it is essential to refine them. It appears that, currently, best results in study units can be achieved if present practice of uniform application of regulations to vast zones is adapted to a system of smaller zones with tailor-made regulations which recognize local characteristics and needs.

Investigations revealed that employment of more imaginative and more functional subdivision techniques is possible only in either the partially developed or in the yet to be developed areas. It was concluded that current subdivision regulations discourage good design and, consequently, are also in need of revision; and that subdivision regulations should be correlated with other development controls, but that they should also be in agreement with the dictums of topography and other peculiarities of a given site for good environmental conditions and design of streetscape in a study unit.

To enhance the visual appearance and image of a study unit, it was found to be essential also that the development and improvement of its street right-of-way be planned, coordinated and executed in accordance with comprehensive development plans for each study unit. Visual characteristics, image and identity of study units and developments can be improved further through the employment of design area techniques.

Footnotes

[1] For definition of this term see Introduction, p. 6.

[2] For definition of this term see Introduction, p. 6.

[3] Kevin Lynch, Site Planning (Cambridge: The Massachusetts Institute of Technology Press, 1963), p. 54.

[4] See discussion of current characteristics, Chapter One, p. 45.

[5] Christopher Tunnard and Boris Pushkarev, Man-Made America: Chaos or Control? (New Haven and London: Yale University Press, 1963), p. 90.

[6] Ibid.

[7] Lynch, op. cit., P. 44.

[8] Harold Marks, "Subdividing for Traffic Safety", Urban Land Institute News and Trends in City Development, (Washington: Urban Land Institute, Vol. XVI, No. 9, 1957), p. 7.

[9] Lynch, op. cit., p. 40.

[10] Kenzo Tange, Tokyo 1960 (Tokyo: Publisher unknown, 1961).

[11] Lewis Keeble, Principles and Practice of Town and Country Planning (London: The Estates Gazette, Ltd., 1961), p. 144.

[12] Ibid., p. 32.

[13] Carl B. Troedsson, The City, the Automobile, and Man (Sweden: Elanders, 1957), pp. 34 and 35.

[14] Ibid., p. 32.

[15] "Building Traffic Safety into Residential Developments", Urban Land: News and Trends in City Development, (Washington: Urban Land Institute, Vol. XX, No. 7, 1961), p. 6.

[16] Marks, op. cit., p. 6.

[17] Urban Land Institute, "The Home Association Handbook", Urban Land Institute, Technical Bulletin #50, (Washington: Urban Land Institute, 1964), p. 177.

[18] Marks, op. cit., p. 6.

[19] Marks, op. cit., p. 7.

[20] Royal Architectural Institute of Canada, Report of the Committee of Inquiry into the Design of the Residential Environment (Ottawa: Royal Architectural Institute of Canada, 1960), paragraph 57.

[21] H.P. Oberlander and F. Lasserre, Annotated Bibliography: Performance Standards for Space and Site Planning for Residential Development, Division of Building Research, Bibliography #19 (Ottawa: National Research Council, 1961), p. (iii).

[22] Charles K. Agle, "A New Kind of Zoning", Urban Land Institute Technical Bulletin #40 (Washington: Urban Land Institute, 1961), p. 66.

[23] British Columbia Lumber Manufacturers Association, A Second Look at Suburbia: Rooms without Ceilings (Vancouver, British Columbia Lumber Manufacturers Association, 1963).

[24] Ibid.

[25] Central Mortgage and Housing Corporation, Principles of Small House Grouping (Ottawa: Central Mortgage and Housing Corporation, (n.d.)), p. 5.

[26] See Chapter One, p. 17.

[27] Royal Architectural Institute of Canada, Loc. cit.

[28] Province of British Columbia, Municipal Act, (A. Sutton: Printer to the Queen's Most Excellent Majesty in right of the Province of British Columbia, 1964), Part XXI, Section 702 (2).

[29] Ibid.

[30] In suburban communities "holding zones" may be zones in which the minimum area of a residential property is limited to one acre, three acres, or more. Many Lower Mainland municipalities use this technique to prevent sprawl of suburban development. This technique permits semi-rural and rural development, but makes development for suburban use an economic impracticability.

[31] Erratum.

[32] Province of British Columbia, op. cit., Part XXVII, Div. (2), Sections 823-856.

[33] See Chapter Three, pp. 94-110.

[34] Urban Land Institute, "New Approaches to Residential Land Development", Urban Land Institute, Technical Bulletin #40, (Washington: Urban Land Institute, 1961), pp. 79.

[35] Considerable savings are possible to a municipality through the usage of varied rights-of-way widths and irregular block and lot patterns. An example of this is to be found in Appendix B.

[36] Urban Land Institute, op. cit., p. 80.

[37] Ibid.

[38] See criticism of current relationships by Royal Architectural Institute of Canada, Chapter One, p. 19.

[39] This 'saving' may not be too noticeable at the study unit scale, but in a larger subdivision it could reach convincing figures. For example, the Analysis of Development Costs, contained in Appendix B, proved that through a more functional layout the area occupied by roads could be reduced from 29.9% to 19.4%, that the area for dwellings could be increased from 70.1% to 79.0%, and that a much needed park, containing 1.6% of study area, could be established. Despite the fact that the number of dwellings to be serviced in the new layout was increased by 14, the servicing costs of the project would have been almost $200,000 less than they are for the existing, ill-suited layout.

[40] "Building Traffic Safety into Residential Developments", op. cit., p. 2.

[41] See Chapter Two, p. 53.

[42] Clive L. Justice, William A. Cobb and Harry J. Webb, "A Brief to the Royal Architectural Institute of Canada Committee of Enquiry on the Residential Environment" (unpublished, Vancouver, 1959).

[43] Ibid.

CHAPTER FOUR

CONCLUDING NOTES

Review of the Study

Chapter One of this study is an attempt to establish the need for an improvement of residential environment within a study unit in a suburban single-family setting. To this end, the needs of man the resident, man the pedestrian and man the driver were investigated through a study of literature.

The investigation revealed that man has failed to create for himself an ideal, "artificial" living environment, partly because he has failed to forsee the impact of the automobile and consequently has neglected to employ adequate techniques for the protection and development of study units. It was observed that, although the automobile has been a boon to suburban development and growth, its mechanical characteristics and demands for space have had also a negative influence both on the environmental quality of study units and

the visual appearance of suburbia and suburban streetscape. The investigation showed that the automobile has begun an insidious piracy on the population and study units in the form of fumes, smell, noise and traffic hazards, and that action is needed to minimize these, or to eliminate them completely.

In Chapter Two the focus of the study is shifted to an analysis of those current suburban development controls and practices which are responsible for the present study unit conditions and living environments, namely, traffic management, street development practices and development controls.

It was observed that most development regulations and practices are quite reasonable and fair attempts to deal with a very complex problem, and that no single development requirement could be labelled as the single reason for the existing adversities in study units. A primary reason for the existence of adversities was linked directly to the observed vehicular and pedestrian circulation patterns, the uniformity and inflexibility of current street right-of-way development and servicing methods, and the arbitrary nature of development regulations and requirements. It was observed also that in most controls there is more emphasis placed on administrative convenience and simplicity than on the promotion of good and functional study unit design. Relating back to the observations made in Chapter One, it is clear

that the emerging suburban streetscape and residential environment leave much to be desired and that controls dictating the development of study units are in dire need of revision, if they are to satisfy to-day's and to-morrow's requirements.

In Chapter Three an attempt is being made to present recommendations, in the order of their effectiveness, for a functional and aesthetic development of study units. The recommendations have been designed to be adaptable as revisions to current controls and do not require their replacement.

It was established through the literature that for optimum results it would be necessary, first of all, to attempt to tame the automobile through the implementation of "functional" circulation plans. The blocked grid concept was found to be the most practical technique for this purpose in established residential areas, while in the yet to be developed areas the most suitable system was observed to be a hierarchical one, correlated to other development controls and recognizing the configurations of terrain. It was established also that it would be essential for the enhancement of streetscape design and environmental conditions to adapt the present practice of uniform zoning regulations to a system of smaller zones with tailor-made controls which recognize local dictums. It was observed, furthermore, that in the development of new areas it would be necessary to employ functional and flexible

subdivision techniques, and that for the further enhancement of the living quality and image of a study unit all development and improvement should be executed with the guidance of a comprehensive study unit development plan.

Appraisal of Assumptions and the Hypothesis

The hypothesis established for this thesis, i.e.,

> that existing street design standards and development regulations adversely affect residential environment; and that, to achieve optimum residential environment, comprehensive street development plans must be an integral part of local government development policies,

made it necessary to establish a number of assumptions without which the study would have been insurmountable due to the subjective nature of the chosen topic and some of the adversities which prompted the writer to undertake the study.

The first assumption, that it is the nature of man to continuously seek to improve his living environments, found ample support, particularly from the works of John Ormsbee Simonds and Kingsley Davis, already at the early stages of research. The second assumption, regarding the desires and duties of elected and appointed civic officials to improve the conditions in the study units of their communities, was difficult, if not impossible, to prove. There are numerous ways and means to an end in a democratic society and, consequently, there is ample room for biased preferences and opinions. The first part of this assumption was actually

quite immaterial to the outcome of this study as the second part - duty, being a condition of appointment and election to office in civic affairs, upheld the assumption beyond all reasonable doubt. The works of Garrett Eckbo yielded sufficent material as support for the third assumption, concerning the overlap of private and public interests and environments in a study unit.

The establishment of the study unit as the most logical and rational unit for the purpose of streetscape and environmental design proved to be satisfactory and found sufficient support from the studies of Central Mortgage and Housing Corporation, Christopher Tunnard and Boris Pushkarev and Kevin Lynch. Although, it became apparent that a study unit does not exist in isolation but rather is a micro-element of a larger entity and, consequently, its potential and environmental characteristics are also determined by conditions and development controls beyond its boundaries.

Intensive investigation of regulations dictating development of a study unit's streetscape, examination of current engineering practices and specifications for the development and usage of a study unit's right-of-way and perusal of works on these topics, prepared by the Urban Land Institute, the Royal Architectural Institute of Canada, Harold Marks, and others, provided substantial support for the first part of the hypothesis "that existing street design standards and

development regulations adversely affect residential environment." The second part of the hypothesis, "that to achieve optimum residential environment, comprehensive street development plans must be an integral part of local government development policies" expanded the scope of the study so that aspects having either a direct or indirect influence upon the qualities of the study unit could be investigated. More than ample material was available for the substantiation of this part of the hypothesis from sources such as the Urban Land Institute, Kevin Lynch, Christopher Tunnard and Boris Pushkarev and Carl Troedsson, indicating that there are almost unlimited opportunities for further investigation and research.

Recommendations for Further Study

During the research and investigation phase of this study, it became apparent that much additional research needs to be done in this fairly subjective field of residential streetscape and environment design before adoption and implementation of these recommendations by public authorities can be expected. Already numerous studies have been carried out investigating single aspects of residential environment at a time, e.g., traffic safety, privacy, servicing, etc., but there is ample need for more such studies.

to deal with other aspects such as the effects of hierarchical street systems on development costs and convenience, the effects of streetscape and study unit environment on land values, the importance of street and area image, the effect of revised development controls on environment, and so forth. Especially important would be the establishment of methods for the measurement and recording of the more subjective aspects in the development of study unit and residential environment.

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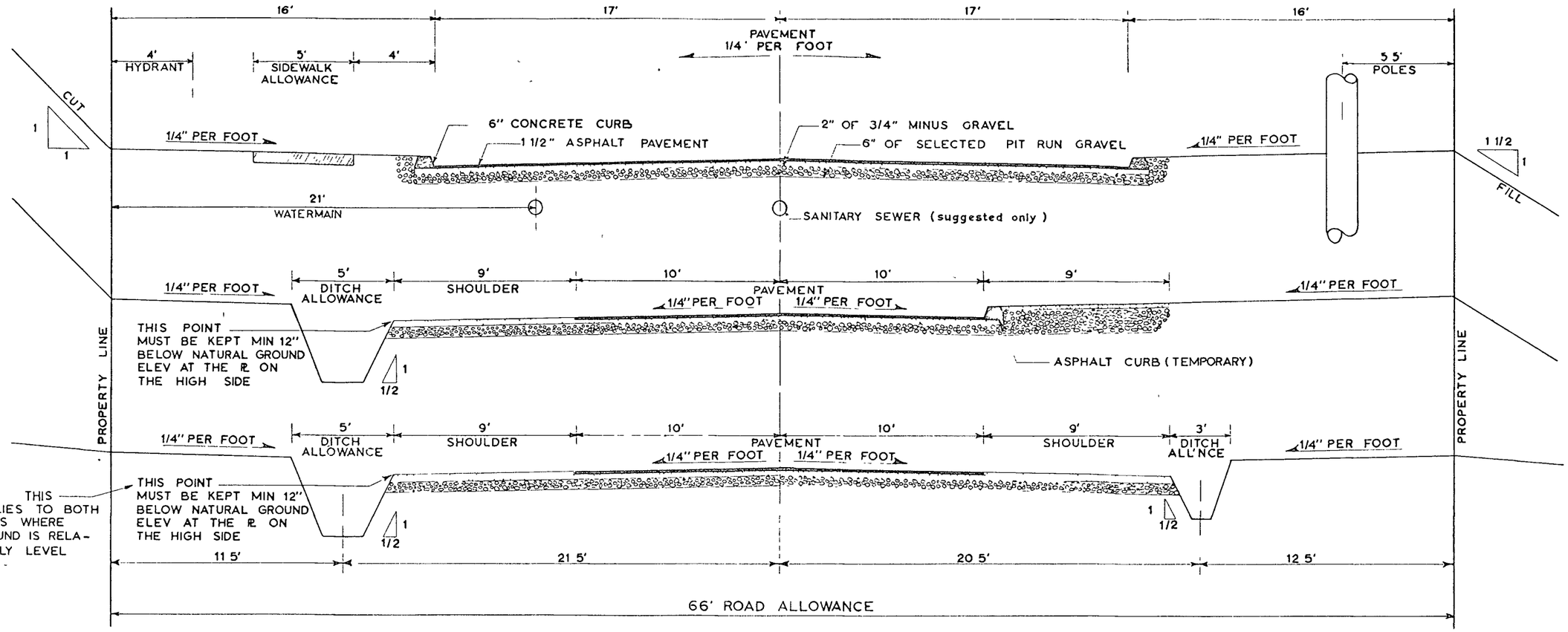
A P P E N D I X A

STANDARD STREET CROSS-SECTIONS



SANITARY, STORM SEWER, POWER CONDUITS AND GAS OFFSETS VARIABLE.

DITCH DEPTH TO BE VARIED AS REQUIRED BY DRAINAGE ENGINEER

GAS AND WATER SERVICES TO BE MIN OF 1.5' BELOW INVERT OF DITCH

FOR CURBED SECTIONS

AT RIGHT ANGLE INTERSECTIONS USE 17' RAD CURVE FOR INSIDE CURB FACE
FOR INTERSECTIONS OTHER THAN RIGHT ANGLE USE RAD TO SUIT CONDITIONS

FOR OPEN DITCH SECTIONS

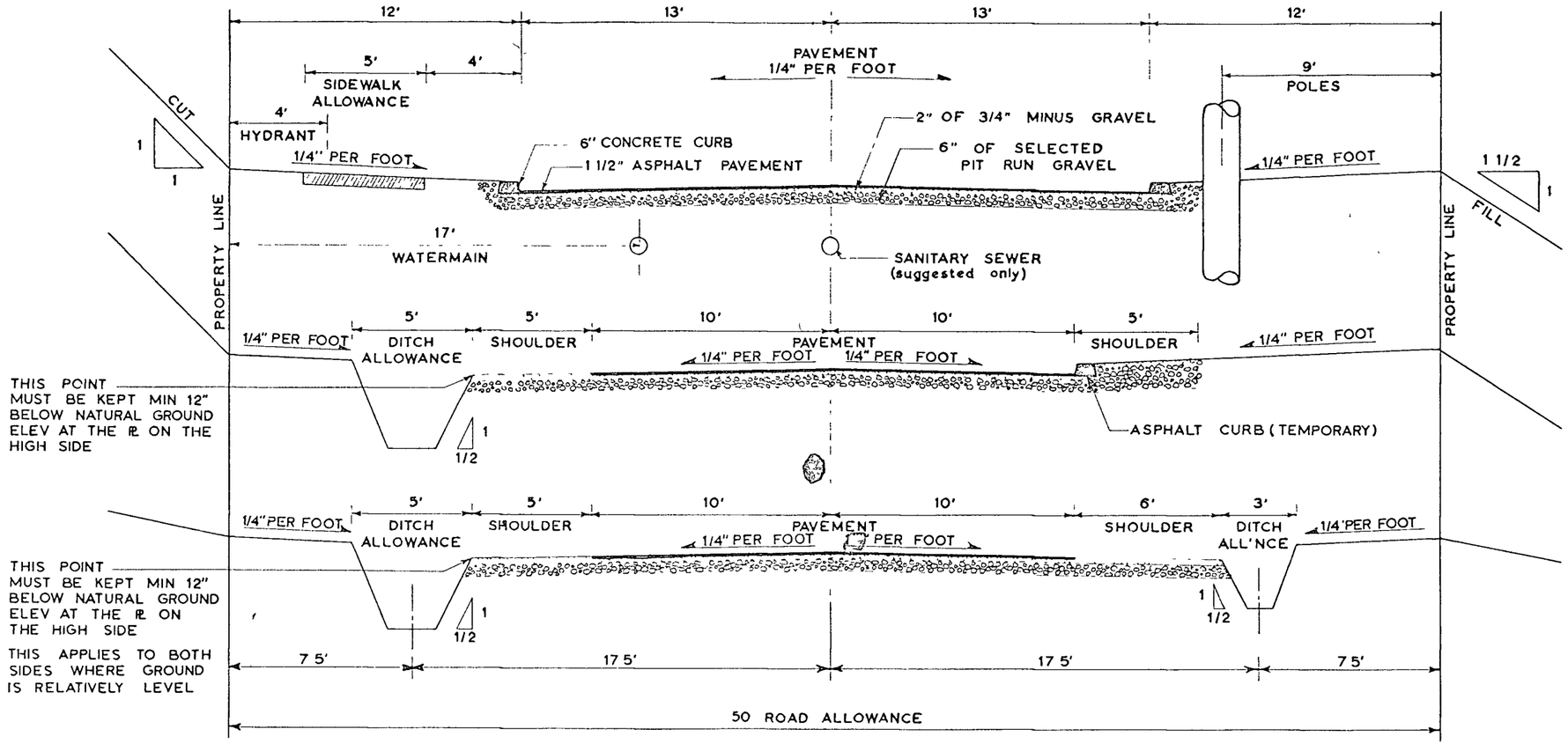
USE 20 RAD CURVE FOR EDGE OF PAVEMENT AT RIGHT ANGLE INTESECTIONS
FOR INTESECTIONS OTHER THAN RIGHT ANGLE USE RAD TO SUIT CONDITIONS

DISTRICT OF NORTH VANCOUVER

MUNICIPAL ENGINEER'S DEPARTMENT

STANDARD STREET CROSS-SECTION FOR 66' ROAD

SURVEY BY	BOOK No	DRAWN BY	J.C.
DESIGNED BY L.K.	CHECKED BY D.A.H.	RECM'D BY	
APPROVED BY MUNICIPAL ENG			PLAN No
SCALE 1"- 5'	DATE AUG 62	SHEET 1 OF 1	R F 15 C



SANITARY, STORM SEWER, POWER CONDUITS AND GAS OFFSETS VARIABLE

DITCH DEPTH TO BE VARIED AS REQUIRED BY DRAINAGE ENGINEER

GAS AND WATER SERVICES TO BE MIN OF 1 5' BELOW INVERT OF DITCH

FOR CURBED SECTIONS

AT RIGHT ANGLE INTERSECTIONS USE 17' RAD CURVE FOR INSIDE CURB FACE
FOR INTERSECTIONS OTHER THAN RIGHT ANGLE USE RAD TO SUIT CONDITIONS

FOR OPEN DITCH SECTIONS

USE 20' RAD CURVE FOR EDGE OF PAVEMENT AT RIGHT ANGLE INTERSECTIONS
FOR INTERSECTIONS OTHER THAN RIGHT ANGLE USE RAD TO SUIT CONDITIONS

DISTRICT OF NORTH VANCOUVER
MUNICIPAL ENGINEER'S DEPARTMENT

STANDARD STREET CROSS-SECTION FOR 50' ROAD

SURVEY BY	BOOK No.	DRAWN BY	J C
DESIGNED BY L K	CHECKED BY	RECMD. BY	
APPROVED BY MUNICIPAL ENG.		PLAN No.	
SCALE 1"- 5'	DATE AUG 62	SHEET 1 OF 1	RF 17 D

A P P E N D I X B

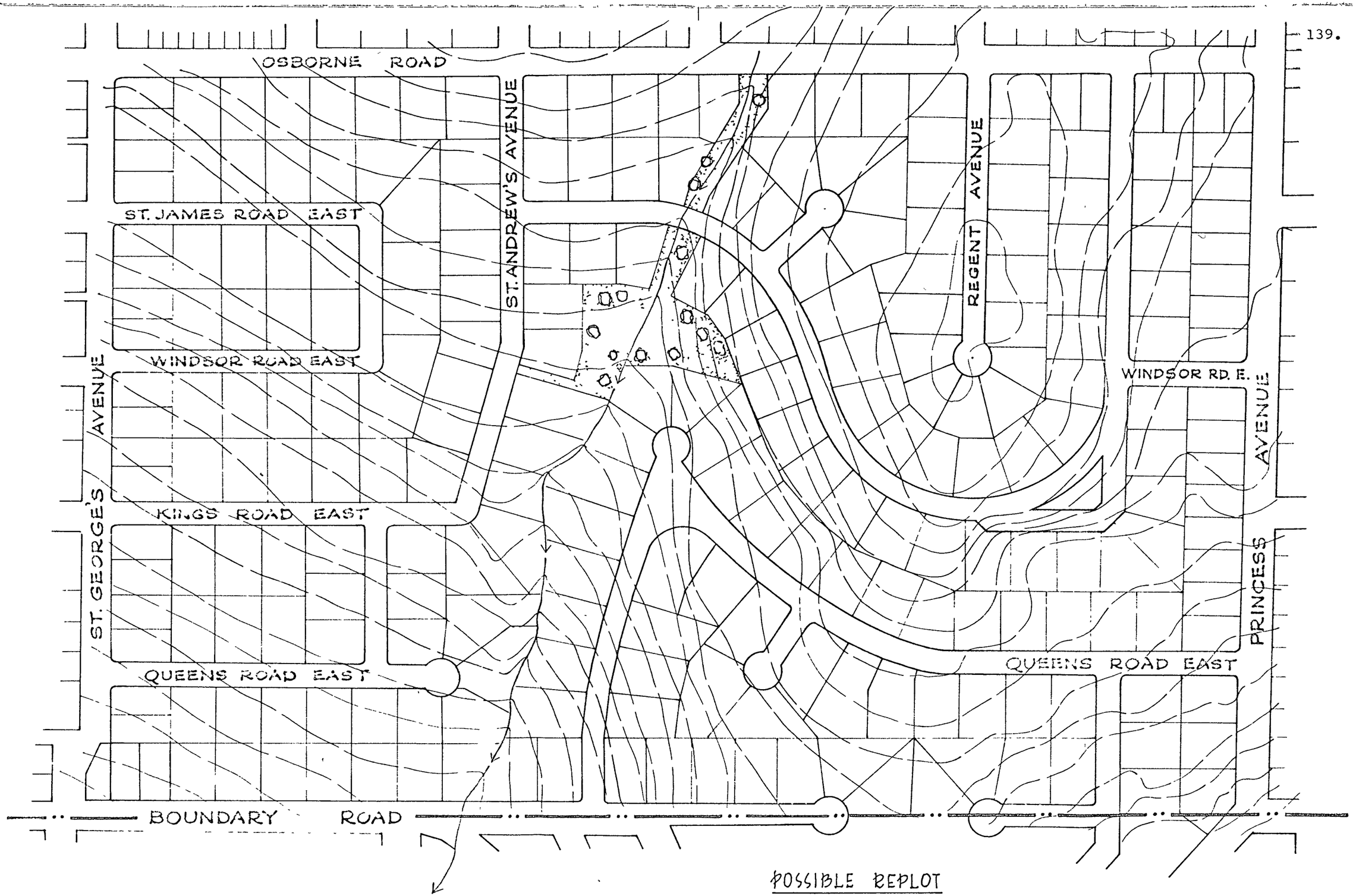
ANALYSIS OF DEVELOPMENT COSTS

ANALYSIS OF DEVELOPMENT COSTS

The Corporation of the District of North Vancouver, B.C.

		Original Layout	Possible Replot
Study area: sq. ft.		4,199,250	4,199,250
acres		96.4	96.4
Residential lots:			
sub-standard lots (100'-)		38	38
standard lots (100'+)		193	207
total		231	245
% of study area		70.1	79.0
Roads:			
½ rd. all'ces : length		8,490	7,835
sq. ft.		280,170	250,915
66' rd. all'ces: length		14,795	-
sq. ft.		976,470	-
50' rd. all'ces: length		-	11,277
sq. ft.		-	563,850
Totals: length		23,285	19,112
sq. ft.		1,256,640	814,765
acres		28.8	18.7
% of study area		29.9	19.4
Park: area in sq. ft.		-	65,340
area in acres		-	1.5
% of study area		-	1.6
Development cost per lot:			
watermains	$	557.38	363.24
drainage	$	1,113.85	896.32
sanitary sewers	$	924.49	743.95
road construction	$	1,533.20	1,129.69
Totals:	$	4,128.92	3,133.20
Total cost per study area:	$	953,780.52	767,634.00

ORIGINAL LAYOUT



POSSIBLE REPLOT