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ABSTRACT:

High density living has become a way of life in the post-industrial cities. The intensification of development in the city centres has led to various problems connected with health and welfare of their inhabitants. The need to control such development within the framework of our democratic set-up and free enterprise has resulted in the evolution of zoning regulations. The controls were initially concerned with minimum standards of daylight, sunlight and open spaces, etc., which has led to various studies on these subjects. The social, economic, geographic and political forces, however, had their own influence on the pattern of development.

The first part of the thesis traces the evolution of high density leading to the developments in bulk control regulations. The extent of research done on daylighting, sunlighting and other elements affecting the relationship of structures has been reviewed to provide a background. The second part deals with the study of an important area in Montreal, which demonstrates the interaction of various forces in the development of its bulk controls, to achieve aesthetic results, and is followed by observations and comments.

BULK OF BUILDINGS IN HIGH DENSITY AREAS & REG. CONTROLS

BULK OF BUILDINGS IN HIGH DENSITY AREAS AND REGULATORY CONTROLS.

A THESIS Presented to
The Faculty of Graduate Studies and
Research, McGill University, Montreal

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for the degree of Master of Architecture

Ramesh Chander Manchanda
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PREFACE:

Relationship between volume and space in urban areas has been an important consideration in building cities since the dawn of history. It has been related to the achievement of an environment which is aesthetically satisfying and represents functional efficiency.

The present day urban areas are more complex than ever before, due to intensity of development, made possible by advances in technology. This has resulted in overcrowding and congestion in city centres, leading to critical problems connected with health and welfare apart from bringing about a lack of aesthetic feeling. Therefore, the need to control the growth of urban areas has given rise to a body of rules and regulations. Since such controls were concerned with land use and building volume, the resulting effects on property values led to various legal problems. The regulations, therefore, were based on considerations of minimum standards of daylight, sunlight, and open spaces, rather than any aesthetic concepts. Mr. Stuenbing in his studies about aesthetic regulations in the United States writes:

> "The legality of obtaining the objectives through aesthetic zoning is a confused question. This confusion stems from the courts predominant refusal to openly accept aesthetic regulations as a proper function of police power. Aesthetics are subjective - a matter of taste and non-measurable."[1]

Recent developments in this regard are, however, encouraging, and there is an increasing tendency on the part of the courts to accept aesthetics as an important part of our daily life.

The present study deals with the evolution of zoning controls concerned with the bulk of buildings in post-industrial cities. The context is North America as I believe that free enterprise coupled with fast rate of urbanization in a comparatively short span of time had created critical problems which resulted in sophistication of bulk control methods in this part of the world.

The first part is concerned with the meaning and effects of high density leading to the bulk controls, and the resulting pattern of development. Their evolution has been traced up to the present day, followed by a review of the research done on various elements which are vital in the relationship of structures.

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[1] Vernon R. Stuenbing Jr., Aesthetic Zoning, unpublished Master's Thesis: Georgia Institute of Technology. 1956.

It will be observed that most of the research is based on certain postulates and empirical observations, etc., and not on any scientific data. Moreover, their application is of a complicated nature and therefore, the findings have not found their rightful place in the zoning controls of North American cities.

The second and third parts are concerned with the case study and observations of an important area in Montreal which demonstrates the application of bulk controls and the interaction of social, economic, geographic and political forces in their evolution, to achieve aesthetic results.

ACKNOWLEDGEMENTS:

I wish to express my deep indebtedness to Prof. Harold Spence-Sales whose able teachings led me to a clearer vision of the subject, and who later helped me in crystallizing my thoughts. I am also thankful to the American Society of Planning Officials and McGill University Library for their help in getting the proper reference material for my research.

Several officials of the City of Montreal were helpful in the preparation of Special Area Study, and in gaining access to the data mentioned therein. I am particularly thankful to Mr. Denis Marchand, Architect; Mr. Jean Jacques Bessete, in charge of Coordination Section; and Mr. Philips Beaureguard, Architect (zoning) of Town Planning Department; Mr. Pierre Roux, Architect, Permits Department, and Mr. G. Richer of Public Works Department.

I am grateful to Mr. Robert Kardos for going over the draft of my thesis and making valuable suggestions, and Miss Judy Rosenbaum for doing the final typing.

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PART I

Chapter I CONTROL OF HIGH DENSITY

The core of city has generally been associated with high density development. It can be defined as a centre of administrative, business, entertainment and cultural activities. It is the home of commercial and professional firms, offices, theatres, cinemas, concert halls, museums, art galleries, etc. All these activities make it a place of action, and the focus of main circulation systems. The core grows with the expansion of trade and commerce and is, therefore, directly linked with the growth of the city. The significance of downtown area is described by Gallion & Eisner:

> "There is a romance associated with the downtown of almost every city. It represents the tradition which springs from

> and clings to a place of the beginning. It has been the place where generation after generation has witnessed the vicissitudes of time. It has been the core from which the vitality of the city has found nourishment and energy. It has been the civic centre, the place of the city hall, the 'big' stores, the theatres; it has been the place where people went to work, and the place where people went out. It has been the terminus, the hub for rail roads, commuting trains and busses. It has been the headquarter for firms and institutions. It has been the symbol of life of the city."[2]

Being associated with so many activities, there is the problem of overcrowding. Interaction results in too much building and volume, too much traffic on a relatively small area of land. It might be considered a virtue that it assumes a compactness of form as the area of hard core of city centres in most of the cases rarely exceeds 160 acres. The reasons for this limited area are the inherent need for swift communication and easy personal contact, etc., for:

> "The automobile is not a natural means of locomotion for shopping; the pattern of business is essentially a pedestrian and not a motorist."[3]

The core, therefore, assumes a human scale related to pedestrian movement, which restricts its spatial growth. The continued demand for building space mainly for the administrative and commercial uses, causes a rise in land prices, resulting in more intensive development. The most glaring example is Manhattan where

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[2] Gallion & Eisner, The Urban Pattern, p. 273-4.

[3] Ibid. p. 283.

a vast increase in building volume has taken place over a period of about 100 years. (Fig. 1)

The relationship of costs with the intensity of development has been established in many studies. An example of land value model for Copenhagen demonstrates the theory of supply and demand, and shows the remarkable similarity between the physical silhouette of the City with the model. (Fig. 2)

The economic justification of such a development is described in "A Review of the Sky-scraper", Mr. J. S. Hornbeck:

> "It is well known that expensive property dictates a tall building for adequate rental returns. The added cost of constructing a high tower is offset by the premium rentals as the upper floors provide such space which is quieter, cleaner, offers daylight, privacy, prestige and a view."[4]

The problem of overcrowding poses a challenge of great magnitude to town planners. It results not only in the choking of the circulation system, but is also a direct threat to the health and welfare of the inhabitants.

In order to understand these inherent problems of the modern city, it is necessary to know its basic structure and the history of its growth, which are discussed in the following pages.

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[4] Architectural Record; March 1957, p. 228.

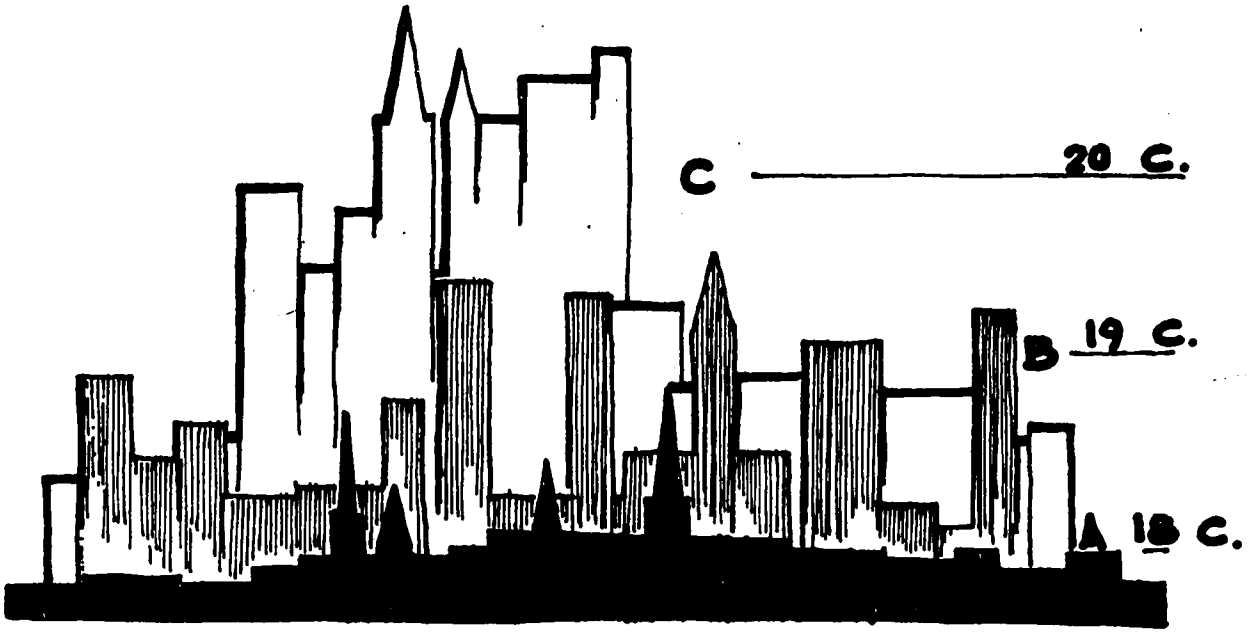

Fig. 1 NEW YORK: Three Stages of Growth.

Illustrates the significance of the changes in scale that have taken place over a century of upward growth.

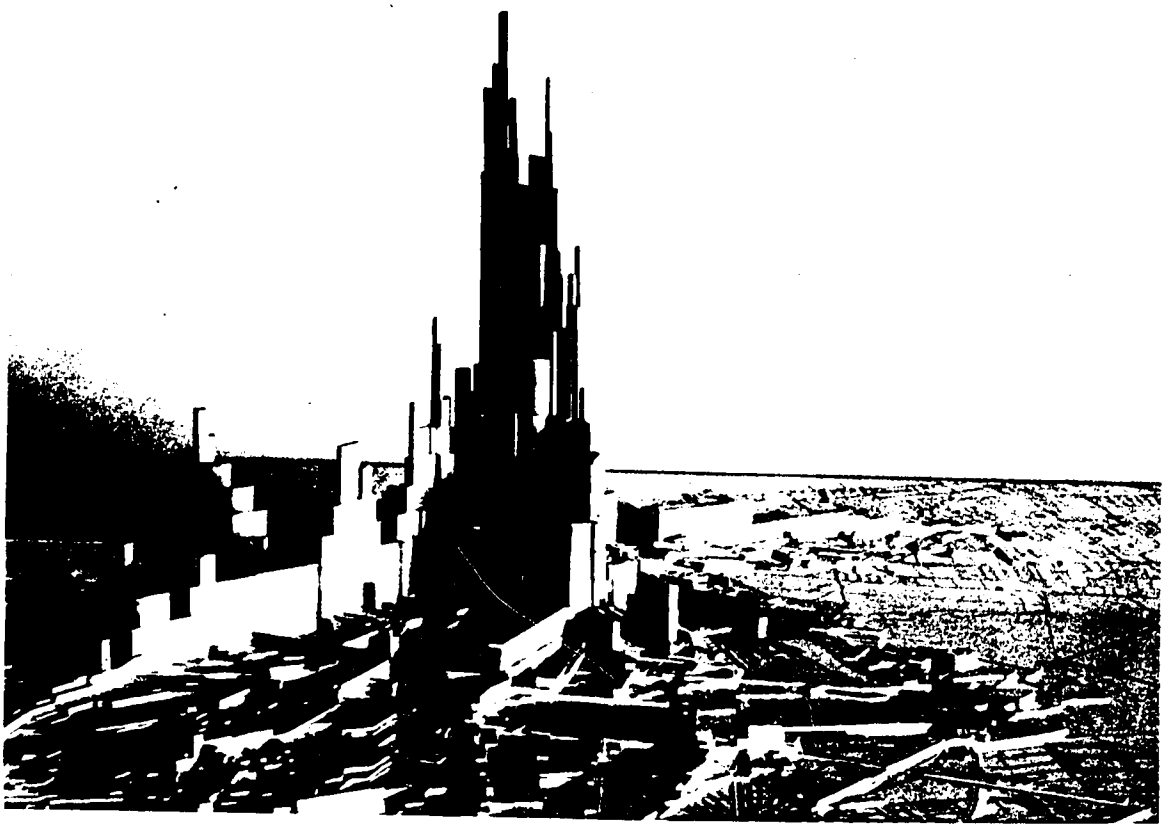

Fig. 2 COPENHAGEN: Land Value Model.

With the desire of everyone to be in the middle of the city, the laws of supply and demand bring congestion.

GROWTH OF THE CITY:

Cities have been the cradle of human civilization and their structures and growth had been closely related to the evolution of the human race. Their study at a particular point in time, therefore, is the study of life styles sustained by them.

The medieval city contained diverse groups of buildings for residential, social, economic and political purposes. Although the siting of buildings eventually took a wide variety of forms, it probably began in a haphazard way around the original market or meeting place.

A political factor which influenced the form and density of the late medieval city was dictated by the needs of defence. Most cities had fortifications. As the population grew, this very solid urban fence forced up the density of buildings within it, and tended to encourage an urban sprawl beyond it.

With the general increase of activities and development of certain crafts into small industries the town continued to increase in population. The problem of finding new sites for industry and additional residential dwellings was solved at first by infilling and building over the town gardens bringing about urban congestion.

Although cities increased in size in 17th and 18th centuries, they remained small by present-day standards. Until the end of 18th

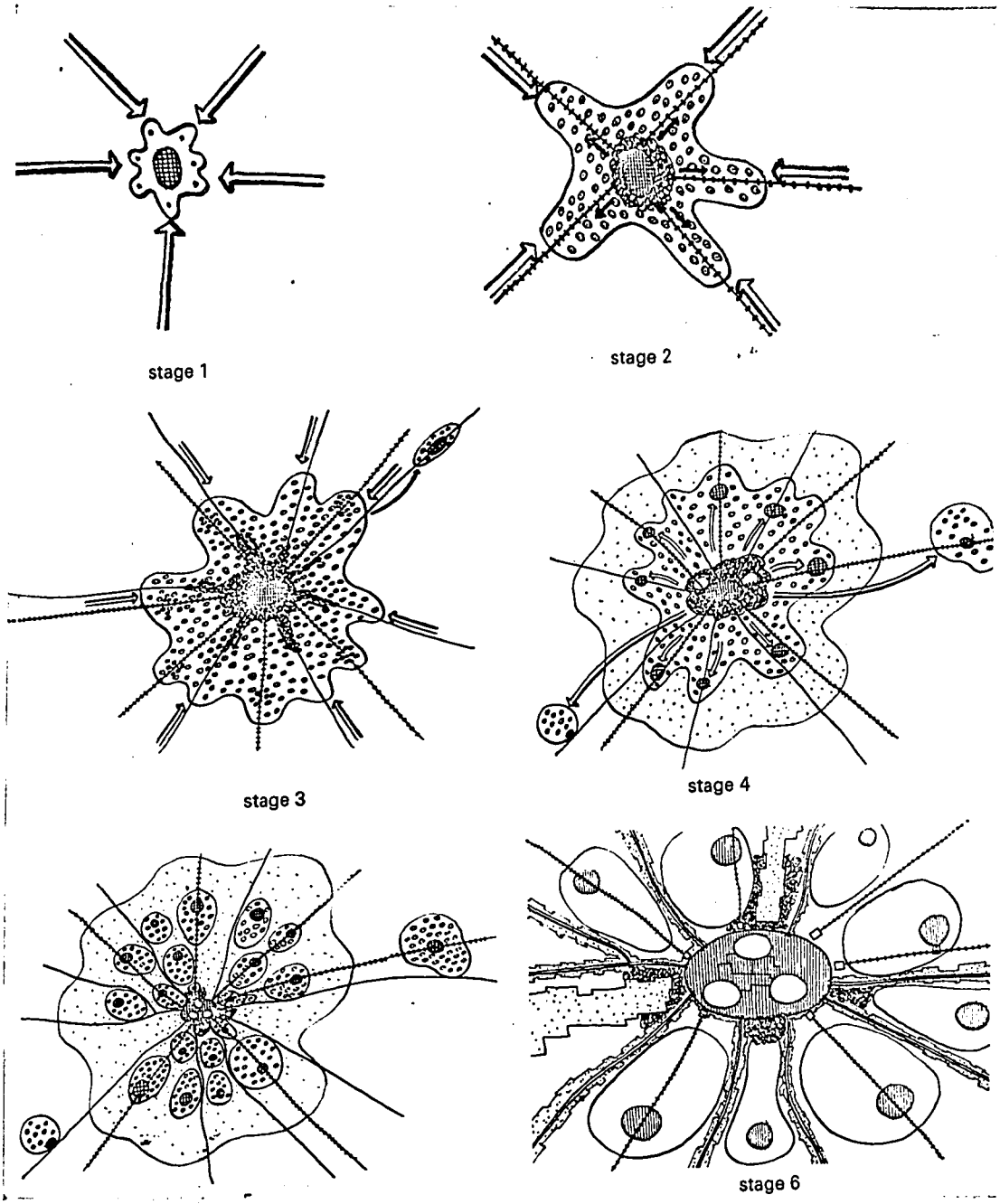

Fig. 3 GROWTH OF THE CITY;

Stage 1:	1770 - 1820.	The modern city begins - industrialization as the magnetic impulse.
Stage 2:	1820 - 1900.	Concentration - some decentralization along railways.
Stage 3:	1990 - 1939.	Congestion - decay in the inner ring; unplanned decentralization.
Stage 4:	1945 - ?	Post-war planned decentralization; comprehensive redevelopment of inner areas.
Stage 5:	? - ?	The city re-created.
Stage 6:	? - ?	The redeveloped centre.

century, one could walk out of even the largest city in any direction in fifteen minutes. Since the majority of persons' movement took place on foot, the character of the inner core was attuned to this scale.

Industrialization:

The industrial revolution had drastic effects on all towns which contributed to it. Industrialization gave rise to intense commercial activity, and in the older urban cores, the all-purpose merchant houses were replaced by large specialized commercial buildings. Although the building volume greatly increased, the space between buildings in the form of roads and open spaces remained as before and, therefore, became relatively smaller. The result was a deterioration in the total urban environment.

Even though the congested conditions in the central areas forced people to move out along railway lines, the continued demand for building space in the centre, mainly for new offices and commercial uses, caused a great increase in land speculation. By the beginning of the 20th century, land in the city centre was not only divided up into large number of ownerships, but also was of prohibitive cost, thus rendering even the remedial planning measures impracticable.

The motor vehicle had its ever-increasing impact on the city and added a new dimension to its form.

At the same time, a number of other technological inventions were developed which, by not being considered in relation to planned development, merely caused an even greater intensification of urban disorder. The electric elevator, for instance, enabled an increasing number of people to work on the same site, while new transportation systems brought commuters flooding into the centres in thousands instead of hundreds.

The problem of time in relation to insufficient planning was created by the increase in building volume which took place in a city without complementary changes accompanying it. The development in Manhattan (Fig. 4) is a case in point.

Fig. 4 EFFECTS OF DEVELOPMENT.

Over a comparatively short period of 150 years, the urban scene has changed drastically. This failure to change the road and open space pattern so as to relate to the intensity of growth is evident from the photograph.

IMPORTANCE OF HIGH DENSITY:

The preceding study established that the structure of cities represents the way of life of a particular period, and high density is a result of industrialization and intensification of commercial activities. This is apparent in the downtown areas of large cities, where land economics has led to higher densities and more intensive development. The demand for space in the centre of cities is ever-increasing and is directly related to the growth of urban population. This phenomenon is further linked with the fast rate of urbanization in the world, in general, and North America in particular.

Donald J. Bogue, a noted sociologist wrote in his paper on "Urbanization in United States", 1950:

> "The 1950 Census of population reported that 64% of the inhabitants of the United States live in urban places as compared to only 5% in 1790. This figure is exceeded only by Great Britain and the Federal Republic of Germany at 79.7% and 71.1% respectively.
>
> "The present state of intense urbanism was achieved by rapid city growth during the past one and one-half centuries."[5]

A glance at the chart in Fig. 5 affords a perspective of

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[5]Hatt & Reiss, Cities & Society, p. 83.

the trend in urbanization in the last 160 years.

Mr. Nat Owings, principal partner of Skidmore, Owings & Merrill, has interesting comments on high density living in an article in 'TIME', entitled "To Cherish Rather Than Destroy", that:

> "Complaints not withstanding, high density living is likely to be the style of the future. All the major cities are as alive and as likely to keep growing as a tropical rain forest.
>
> "There is no possibility of their dying. They are viable, they are vibrant, and their growth is rank.
>
> "By the year 2000, some 400 million Americans will be living in roughly the same area as today."[6]

It might, therefore, well be assumed that intensity of development is an inevitable phenomenon. It is as much a part of life as the city itself. High density is here to stay.

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6. TIME: Aug. 2, 1968; Special Issue "Building for the Year 2000" p.12 .

URBAN AND RURAL COMPOSITION AND RATE OF URBAN AND RURAL GROWTH. 1790 - 1950 Fig. 5

	Percentage of Total Population Classed as Rural			Percentage of Change Over Preceeding Decade		
	Urban	Rural		Urban	Rural	
Year		Non-Farm	Farm		Non-Farm	Farm
New Urban Definition						
1950	64.0	20.7	15.3	22.0	23.0	-19.3
Old Urban Definition						
1950	59.0	25.7	15.3	19.5	43.2	-23.6
1940	56.5	20.5	22.9	7.9	14.2	0.2
1930	56.2	19.3	24.6	27.3	4.4	
1920	51.2	48.8		29.0	3.2	
1910	45.7	54.3		39.3	9.0	
1900	39.7	60.3		36.4	12.2	
1870	28.2	71.8		42.7	25.7	
1860	19.8	80.2		75.4	28.4	
1840	10.8	89.2		63.7	29.7	
1800	6.1	93.9		59.9	33.8	
1790	5.1	94.9		----	----	

HEALTH & WELFARE:

High density in city centres poses many problems of overcrowding and congestion which are intimately linked with the health and welfare of the people. Lack of comprehensive planning and development in such areas has resulted in buildings placed close together depriving the inhabitants of essential daylight, sunlight and fresh air, etc. Another important element denied in condition of overcrowding is open space for rest and recreation which has almost disappeared in the process of intense development, creating critical problems connected with psychological health of society. Too much building on comparatively small lots deprives children of play areas, increase dangers of fire hazards, and spread of infectious diseases. The problems of privacy are connected with the provision of open space between structures which not only is concerned with the visual factor, but also with noise.

The intensity of activities coupled with narrow urban spaces creates further problems of traffic congestion and choking of essential services. The generation of increased noise and air pollution, etc., are some of the by-products in which human beings must live unless something is done to relate the urban environment to their basic physical and psychological requirements. The absence

of these amenities causes tendency for people to live away from the city centre, but they have to come back for work, causing additional strain on the circulation system.

All these problems point out the desirability to create a proper order in urban areas which meets the minimum biological needs of man, represents functional effeciency and provides an environment which is aesthetically satisfying.

AESTHETIC CONSIDERATIONS:

The problem of aesthetics in urban environment is an old topic. In Ancient, Medieval, Renaissance, as well as modern towns, consciously or unconsciously, efforts have been made to build them as architectural creations, with individual or group compositions, to give an aesthetically pleasing experience to the inhabitants. In modern urban centres, the aesthetic environment is complex. As compared to a relatively very small scale of activity in old towns, the centres now consist of man-made features, elements of motion, time and results of social, economic and political forces.

According to Frederic Gibberd, the physical qualities of a town have spiritual overtones and therefore are as important as its economic functioning. He writes:

> "As a physical expression a town is a thing to be seen and since the visual sense is a channel to the soul, that which is seen should be as beautiful as a man can make it. The town must not only work properly and be economically sound, but it should also give pleasure to those who look at it. The technical solution to the functional problems must be fused with aesthetic feeling.
>
> "The most essential characteristics of urban design is the combination of different objects into a new design.

> The designer must consider not just the design of the object itself but its correlation with other objects. Such a factor is usually ignored today."[7]

In this context space between structures assumes important attributes. The significance of space is not so much that it is an area in which buildings look or an area to look at buildings, but that it has an existence of its own, in its own right. The Greeks recognized this and it was an important element in their art and religion. The relationship of form and space, therefore, is the critical factor in urban aesthetics, as well as in urban design.

In the development of cities, there is a need to think beyond the design of buildings and circulation system. It is necessary to establish volumes of space that are in scale with the needs of the present time, and in harmony with present technology.

Urban aesthetics has been an important topic of discussion and research by various town planning organizations. In one of the reports by a committee of the California Chapter of American Institute of Planners on the subject of urban aesthetics, it was stressed that:

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[7] Frederic Gibberd, Town Design, p. 9.

> "When we write of urban aesthetics, we are writing about the character of our city; about the aesthetic reactions we all feel, as we go about our lives in urban areas. These aesthetic reactions are aroused by more than just the things we see, the sense of smelling, feeling and hearing - all add sometimes subtly, sometimes powerfully - to our awareness of being in the city and to our feeling towards that city.
>
> "Urban aesthetics as we understand this term deal with all of man's urban, physical environment. We are concerned with its effects on man, as it is perceived through all the senses."[8]

Aesthetic and economic function have also been related by some of the recent writers on the problem of town planning. To quote Tunnard's book entitled "The City of Man":

> "It is now quite obvious that the hand of the artist has become necessary in order to remove from city the areas of ugliness, as well as misery, and to replace them with the useful and the beautiful, or the city will not function the way that now we desire. It has been discovered rather late in the day that aesthetic is ultimately related to the economic function in urban planning."[9]

Plans for "The Boston Centre" (Fig. 6) by Walter Gropius and "Centre for Fort Worth, Texas" by Victor Green are few instances which show the possibilities of achieving a balance between aesthetics and functional efficiency in high density areas.

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[8] American Institute of Planners, California Chapter, Report of Urban Aesthetic Committee: Nov. 1954. Cited by Heinz Fenichel, Sound as a Factor in Urban Aesthetics: unpublished Masters thesis, University of California, 1955. p. 14

[9] Christopher Tunnard, The City of Man; New York & London: 1953 p. 349

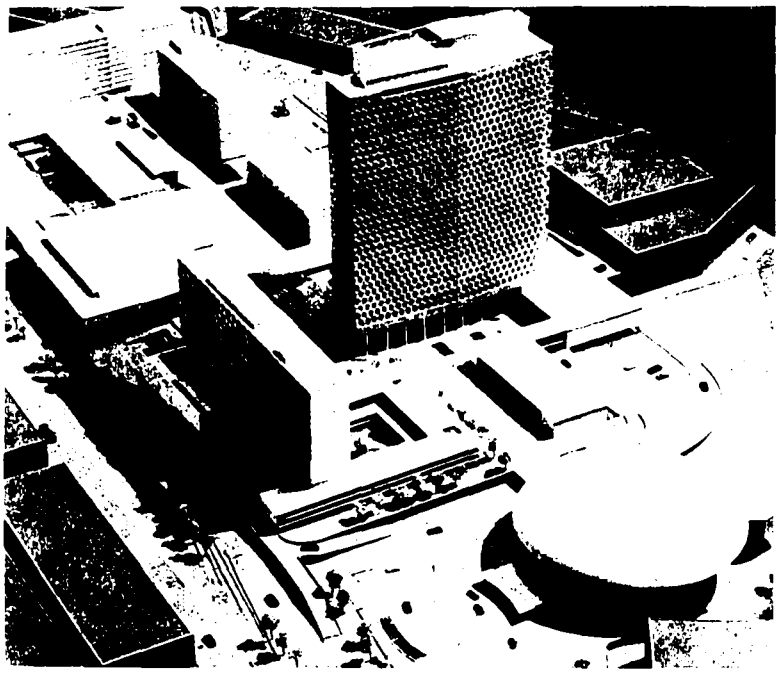

Fig. 6 THE BOSTON CENTRE: 1953.

A highly imaginative redevelopment proposal which was not realized. The design aimed at comparative low site development, one high tower to achieve light, air and scale, and traffic separation.

Fig. 7 PLAN FOR THE CENTRE OF FORT WORTH, TEXAS:

The design aimed at efficient circulation system, traffic separation and harmony between form and space.

NEED FOR CONTROLS:

In order to provide a framework of development and growth, the cities need extensive zoning regulations, based on modern research and technology. The extent to which the architecture of buildings can be effectively controlled, has become of increasing importance and the progress in such controls and establishment of their legal basis has been the topic of discussion in various town planning conferences. In one of the papers recently presented by Charles S. Chaney and Elener Musick, it was stressed that:

> "The architectural control and architectural programme of the city are as definite and inseparable a part of a comprehensive city plan as zoning or the major traffic street plan, etc. It is astonishing that with the marked progress in municipal planning and government in this country, some of our chief authorities overlook the important matter - the architecture - the biggest and the closest mass on the horizon of every city and of every life in it."[10]

Apart from the aesthetic consideration of spatial relationships, the critical problem in regulations is the relationship between them. There are two main considerations of the space body around urban structures.

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[10]Harold McLean Lewis, Planning the Modern City, Vol. I, p. 270.

1. The interior requirement of ensuring sufficient light, air, sound-control and privacy, etc.

2. The exterior demands of circulation, streets, side walks, parks, etc.

The preservation of space for consideration of light and air continues to be the criteria for determining the distance between buildings, but relative importance has somewhat diminished by advances in artificial illumination, sound insulation and air conditioning, etc. It is therefore possible that the relationship of building volume and space in future will be based more on exterior requirements than the interior demands. The amount of building floor space in relation to exterior circulation may become critical factor, as the requirements of vehicular and pedestrian traffic now present an almost insurmountable problem, and it is compounding annually.

However, current concern for space to protect light and air, etc., will still be important considerations in dealing with the development of existing areas, and to derive methods by which set backs might compensate for increasing building heights and volume.

There is an inflexibility in current methods for preserving open space. The minimum standards permitted by law, become

the maximum in practice. Many of the early sky-scapers developed in pyramidical form (through restrictions on height, zoning, enforcing set backs to preserve minimum angle of light from the streets), when occured together produced an overpowering effect of mass, and reduced the streets to dark alleys. (Fig. 8)

The conventional set back requirements that produced the familiar shapes variously referred to as "cake mould" or "Zigguart" were modified recently to afford more architectural flexibility without sacrificing the basic needs of the inhabitants.

The improved regulations and advances in architectural concepts, have freed the buildings from the tyranny of street frontages, making possible a plastic grouping in space of great aesthetic significance.

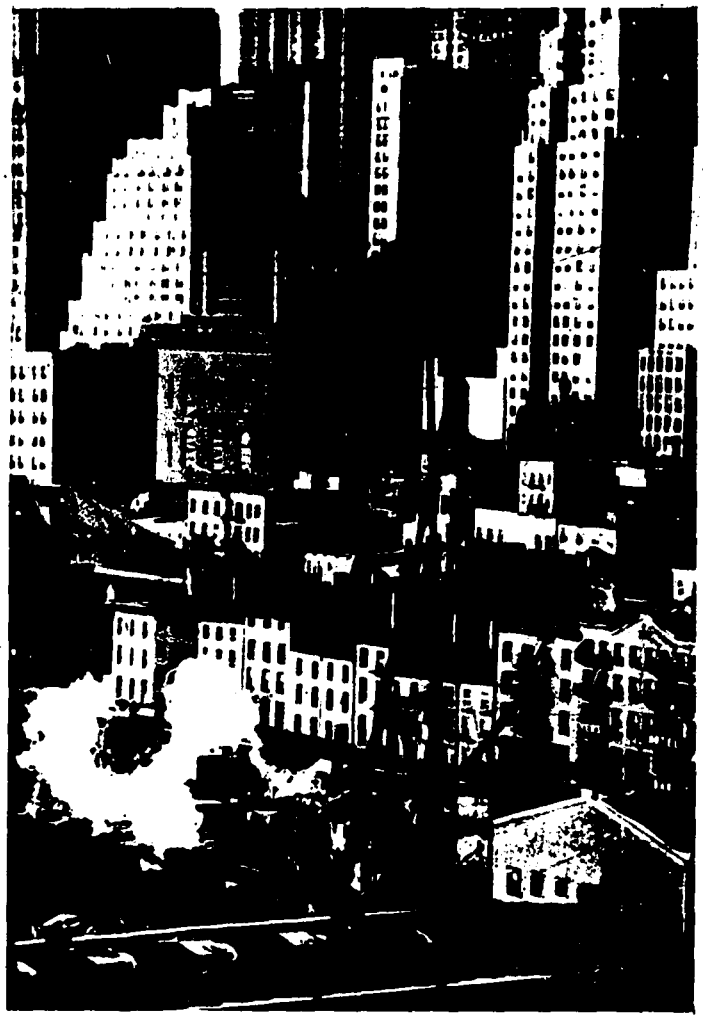

Fig. 8 NEW YORK:

The development was essentially incomprehensive as the street pattern failed to change in relation to vastly different scale of the buildings. The attempt to achieve daylight through zoning regulations resulted in unfortunate architectural form.

Chapter II REGULATORY CONTROLS

HISTORICAL BACKGROUND:

The period prior to the 19th century is full of theories about urban form based on elementary geometry and the relationship of simple numbers which were further intricately linked with religion and philosophy.

The intuitive application of planning principles was formulated at the turn of the 20th century through a written summary and an illustration of the principles of aesthetic composition by CAMILLO SITTE. Sitte - a Viennese architect published a work by the name of "The Art of Building Cities" (1889) in which he summarized principles of public architecture and their application. He held that architecture was an important environmental factor due to its visual stimulation, and therefore discussed the problems of relationship of height and width of volume and of architectural character of the buildings in an urban setting. He writes:

> ".....The minimum dimension of the square ought to be equal to the height of the principle building in it. The maximum dimensions should not exceed twice its height, unless the design supports greater dimension. The observer should be twice the height away from a building to view it properly or 27 degree angle up to the top of the structure. For a group of buildings it should be 18 degree angle."[11]

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[11] Frederic Gibberd, Town Design, The Architectural Press, London; Chap. IV. p. 88.

In a later work on town design "HEGEMANN & PRETTS"[12] confirmed Sittes' observations. An outgrowth of this effort was further works by UNWIN and others dealing with the same topic.

Johnson & Marshall in their book "Rebuilding Cities" write:

> "It was the sense of proportion and relationship which created an urban scene of narrow winding streets, leading to and opening suddenly on the greater urban spaces, enriched with public buildings of dignified scale, and soaring vertically, thus creating a meaningful contrast, including strong feelings of variety and surprise.
>
> "Thus there were established a whole set of rules for the urban designer which survived until the 20th century. Based on the concepts of visual order, these rules were simple geometric formulae.
>
> "Apart from the techniques of geometrical layouts and pattern book classification, other elements were brought about for creation of post-Renaissance urban scene. One such was the development of regulations for controlling buildings which began after the great fire of London. (Fig.) These regulations affected not only building techniques in terms of stability and fire resistance, but also the innumerable minor objects which previously tended to regulate street layouts."[13]

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[12] Ibid., Chap. IV, p. 88.

[13] Johnson & Marshall, Rebuilding Cities.

DEVELOPMENT OF CONTROLS:

Owing to the absence of comprehensive planning and coordinated control over the last 150 years, a series of maladjustments have taken place in the urban environment. The slow process of piecemeal renewal and increasing property values has held this old pattern in a firm grip. Another problem of time in relation to the lack of planning is created by the increase of building volume without complementary changes accompanying it. The developments in Manhattan are most notable in this context, where vast increase in building volume has occured on each site.

Since there were no effective planning controls in most of the cities, to deal with a piecemeal situation of growth, a free-for-all took place resulting in speculative property dealing. Large buildings tended to overshadow their neighbours to deny them their right of light when built alongside with a common party wall. Further problems occured when even rights of access were often transgressed.

Evolution of Zoning Law:

The free enterprise system which brought about the redevelopment and enlargement of these new commercial buildings, was thus forced to bring into existence a new system of building controls which gradually evolved into a code of building bylaws. Simple angles

of light controls were instituted in some cities, so as to prevent buildings facing a street taking too much light from those on the other side, and the need for fire-fighting brought others, such as the 80 ft. maximum vertical height once permitted in London.

Stephen Sussna writes in an article "Bulk Control & Zoning":

> "The construction of equitable building at 120 Broadway in Manhattan without a set back and with a shadow cast over 7 acres of adjacent property seems to have been one of the major triggers for public support for the first zoning ordinance in the United States."[14]

In any case the concept of zoning was an ingenious device brought about by sophisticated and knowledgeable men who believed that the courts could be induced to permit municipalities by an extension of the common law nuisance doctrine to build a comprehensive land use regulatory scheme under the aegis of police power. Richard F. Babcock writes:

> "Zoning was no more than a rational and comprehensive extension of public nuisance law with the great advantage of providing the land owners with knowledge before the fact of what they could and could not do with their land."[15]

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14. Stephen Sussna, Bulk Control & Zoning, Land Economics, May, 1967. p. 156.

15. Richard F. Babcock, The Zoning Game. p. 23.

The introduction of these measures was hailed in the United States, as it provided great relief 'to one and all'. According to Alfred Bettman, a well known advocate of the time, the advantages of zoning:

> "The term public nuisance has ceased to have any definite meaning as a measure of legislative power...A lawyer would often hardly hazard a guess as to whether his clients' proposed industry will or will not be declared a nuisance. The zone plan, by comprehensively districting the whole territory of the city, and giving ample space and appropriate territory for each type of use, is decidedly more just, intelligent, and reasonable than the system, if system it can be called, of spotty ordinance and uncertain litigation, about this definition of a nuisance."[16]

The Zoning Law:

The city zoning ordinance was an attempt to solve existing problems by channeling private action along lines which would develop land more rationally.

In early zoning cases, the primary interest was in protecting rights and the general welfare was given narrow interpretation. The purposes were usually set forth in the State enabling act permitting zoning. The grant of power provision of a model zoning enabling act read as follows:

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[16] Richard F. Babcock, The Zoning Game, p. 26.

> "For the purpose of promoting the public health, safety, morals, convenience, order, property and general welfare, the chief legislative body of any municipality is hereby empowered in accordance with the conditions and procedures specified in this act, to regulate, the location, heights, bulk number of storeys, and size of building and other structures, and percentage of lot which may be occupied, the sizes of yards, courts and other open spaces, the density and distribution of population, and the uses of buildings, structures and land for trade, industry, residence, recreation, civic activities and other purposes."[17]

Zoning ordinance, in general, operate in two different ways. They regulate the use to which land is put, and they control the bulk of buildings; i.e. the size, shape and placement of buildings on the land. Use regulations designed to prevent incompatible mixture of land use, have received the major attention from courts and writers. Bulk regulations on the other hand have gone relatively unnoticed.

Bulk controls have been evolved as an integral part of the Zoning ordinance in order to achieve three ends.

1. Control over density of population in living and working areas;
2. Adequate daylight of buildings; and
3. Sufficient open space around buildings for rest and recreation.

Population density control is aimed at solving some of the problems of congestion. It strikes at the root of the traffic

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[17] Chicago International City Managers Association, 1948, Local Planning Administration: 2nd Ed., p. 297-298; cited by Vernon R. Stuenbing, Jr., Esthetic Zoning.

problem by preventing over concentration. It also furnishes a sound basis for planning municipal services such as educational and circulation system in an area. Daylighting of buildings and open space provision are supplementary to density controls but no less vital, for they are also aimed at increasing the amenity of city life and correlated with density controls.

The main objective of early zoning ordinances such as the New York Ordinance of 1916 was to secure adequate daylighting of buildings in downtown areas and to prevent congestion by putting limits on the size of sky-scrapers - then a new phenomenon. Control over population density, if it was considered at all, was achieved as a by-product of these regulations.

Today the situation has reversed. The emphasis is now on control over the levels of density in residential areas, even though daylighting and open space regulations in residential and downtown areas are still needed, for general density control does not assure adequate daylight or sufficient open space.

The devices available to achieve these ends have also changed radically. Height limitations, set back and open space requirements were usually the sole means of regulating the building shape, volume and placement on the land in early zoning ordinances. Since then clearer definition of the goals have led to the refinement of the old techniques and development of the new ones.

A Study in Techniques:

The methods for regulating the bulk of buildings had to be based on purely objective considerations; i.e. projected density, present congestion, proximity to working areas, transportation facilities, land values and the minimal requirements of daylighting and open spaces, etc., in order that such regulations are framed within the meaning of any state enabling act for:

> ".....They (courts) have declared invalid only those techniques which were not encompassed in the state enabling act, or had no relation to the legitimate aims of zoning; i. e. racial zoning, minimum height regulations, minimum cost requirements, and architectural conformity restrictions have been struck down. Since controls over daylighting, density, and open space do not come within this ban, the legality of bulk control techniques present no serious problem."[18]

Various techniques developed to control the bulk of buildings are discussed under three major headings:

1. Density Controls
2. Daylight Controls
3. Open Space Regulations

Many zoning ordinances employ only one or two techniques to secure the three-fold aim. While one method does affect the other to some extent, it can only be termed as incidental, and obviously no one method can replace the other.

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[18] Building Size, Shape & Placement Regulations: Bulk Control Zoning Re-Examined: Yale Law Journal, Vol. 60:506, March 1951, p.512.

1. Density Controls

There are three basic methods of regulating density;

(a) Control of the maximum building shape (envelope) through spacing controls.

(b) Control of the number of people on the land.

(c) Control over the volume and floor area of the building.

(a) Building Shape Controls:

Regulating the shape of building has been one of the oldest practices, but least effective for controlling density. The chief techniques are the height, set back and yard or court regulations. Although these were initially designed for fire-fighting and to ensure adequate daylight in buildings, they still remain the only density controls in most cities of North America.

The heights of buildings are stated in terms of specific number of feet, storeys or multiple of street widths. Higher buildings are permitted if, above this height the building is set back from the front or rear lines. In most crowded areas the set back ratio might require a one ft. horizontal set back for each four feet increase in height; in less crowded areas the ratio might be one ft. back for each half foot increase in height.[19]

[19] Ibid., p. 514

"New York, for example, is divided into eight height districts ranging from the 'class two and one-half district' to the 'class one-quarter district'. In the former class, which permits the highest buildings, the building can go straight up from the street to a height of two times the street width. It must then be set back from the street line at a ratio of one foot for each four feet increase in height.

"In the lowest height district no building can be erected more than one-quarter times the street width at the street line, and thereafter it must be set back at a rate of two feet for each foot increase in height.

"Like most other cities, New York has certain exceptions to these rules. For example, if the street is less than fifty feet wide, computations can be based on a fifty-foot street, and if the street exceeds 100 feet in width, builders must assume a street width of only one hundred feet."[20]

The set-back regulation has brought about a distinctive pyramid effect of many buildings in downtown New York and other large cities. (Fig. 9) Many cities permit buildings to go even higher than the set-backs allow if it occupies only a certain percent of the land. In others the height of towers is unlimited.

"New York permits unlimited height of towers if the area of the building is less than 25% of the lot area and the tower is at least 75 feet from the middle of all streets on which it faces.

"Cleveland and Philadelphia are two of the numerous others which permit unlimited towers, provided the tower is not

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20 "Building Size, Shape & Placement Regulations", Yale Law Journal, March 1951, p. 514.

Fig. 9 NEW YORK: Lower Manhattan.

Illustrates the need for control of volume and daylight in city centres.

within one mile of an airport, does not exceed 25% of the lot, excluding required yards, and is at least 25 feet from the lot lines, and in Philadelphia, provided the tower area is not more than 25% of the lot area, is not within 25 feet of lot lines, and the width of the tower is less than half the width of the lot line toward which it faces."[21]

Yard and court regulations further limit building size, even though in high-density areas the requirements may be small.

Regulation of building height based on angles of light and width of streets in London is defined in the official report "Reconstruction in the City of London", by Dr. C. H. Holden and Prof. W. G. Holford.[22] (Fig. 10)

Through these measures it was possible to determine the maximum building size for each lot in the high-density areas of the city, and translated into cubic footage or square footage of floor space, and arrive at an estimate of the population allowable in any area. Such a process, however, is costly, time-consuming and difficult to manipulate. Moreover, yard and height regulations do not control density adequately, since most yard requirements are relatively small, aimed at providing only daylight and open space - they do not effectively limit the building size.

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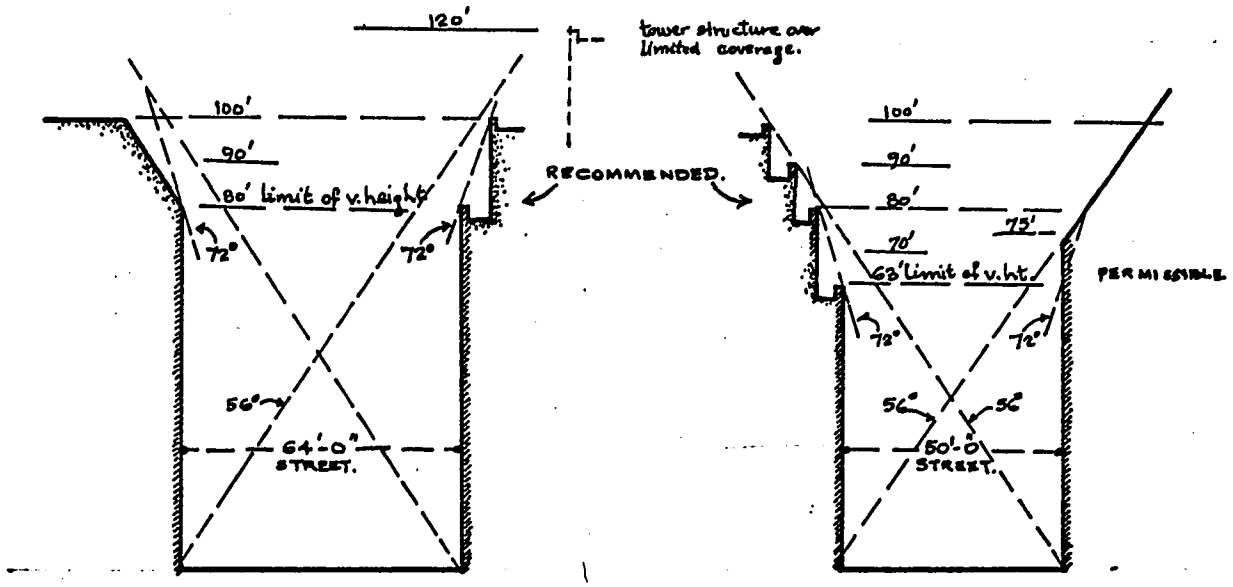
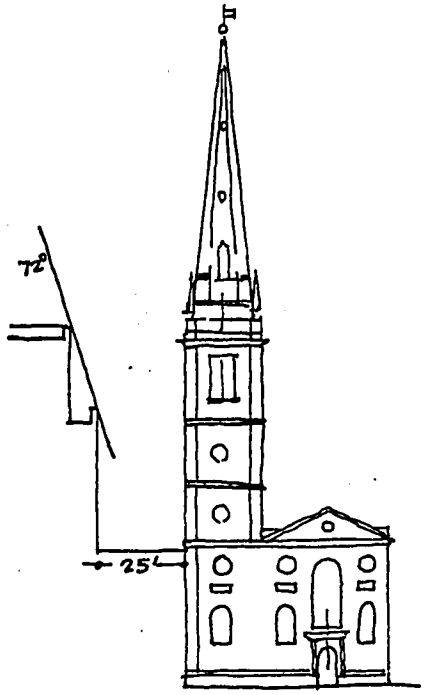
[21] Ibid., (extracts from foot-note no. 35). p.514.

[22] C.H.Holden & W.G.Holford, "Reconstruction in the City of London". Official Report. R.I.B.A.Journal, 1947, p.426





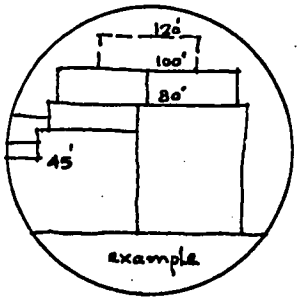


FIG. 10. RECOMMENDATIONS ON HEIGHT BASED ON ANGLES OF LIGHT.

The Yale Law Journal writes:

"The yard requirements for residences in Cincinnati in Business and Industrial districts - front yard: none required, side yard: 1 storey - 3 feet, 2 storeys - 6 feet, 3 storeys - 9 feet, etc., (but no side yards are required if non-residence users occupy lower floors); rear yards: 1 storey - 15 feet, 2 storeys - 20 feet, 3 storeys - 20 feet."[23]

If yard requirements were increased to control density more effectively, undesirable results will follow; i.e. the freedom to place the building on the site will be restricted. Some cities have avoided this result by use of the coverage regulation by restriction on the percentage of the lot which the building can cover.

The coverage requirements are superior to yard regulations as a density control, but both techniques are unsatisfactory, being indirect and have to be correlated with height limitations to be effective.

(b) Population Controls:

These regulations are only effective in residential districts or multiple dwelling districts in high-density areas, and restrict number of families or persons on specific lots. They therefore vary from low-density to high-density areas, and in later case, the lot requirements are as low as 200 square feet per family.

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[23] "Building Size, Shape & Placement Regulations: (foot-note no. 38), Yale Law Journal, March 1951, p. 515.

"Oklahoma City, New Orleans, and Allentown, Pennsylvania base their controls on lot area per family. Los Angeles, Toledo and Providence, Rhode Island use lot area per dwelling unit. In city master plans, the assumption is usually made that one family uses one dwelling unit so there is very little difference between these two bases. The proposed Detroit ordinance is based on living rooms and bedrooms and the proposed San Francisco ordinance employs living rooms and bedrooms in some cases and takes the dwelling unit as the basis of others.

"The requirements may also be stated in reverse; i.e. persons, families, or dwelling units per acre. Cincinnati employs this method in certain multiple dwelling districts, (18 families per acre in the 'B' zone, 28 families per acre in the 'C' zone and 50 families per acre in the 'D' zone). Most master plans are drawn up with persons per acre as the basis and are usually translated to families per acre on the basis of 3.6 persons per family. The draft development plan for London employs the persons acre basis, but it may soon be changed to rooms per acre since this is considered a more 'convenient' standard to work with.

"Los Angeles shows both extremes. It requires only 200 square feet of lot area for each dwelling unit of less than three rooms in the 'R5 Multiple Dwelling Zone', but in the 'RA Suburban Zone' requires 20,000 square feet per dwelling unit and in the 'A1 Agricultural Zone' five acres are required for a one-family dwelling."[24]

Such controls are more direct as the population density can easily be determined and therefore more popular.

The direct techniques, however, are disadvantageous or they encourage buildings for large or well-to-do families, and dwellings for individuals, couples or families with small means are excluded.

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[24] Ibid., (extracts from foot-note no. 43)

(c) Volume or Floor Area Controls:

Since the number of people using a given amount of volume or floor area can be estimated, it is possible to control the number of occupants. These devices are technically called Cubage and floor area ratios. Their great advantage over height, set-back, and yard and court regulation is that they control directly the size of the building, and unlike other regulations of density, can be applied both to commercial and residential buildings.

The Cubage regulations, the older of the two controls, has been applied almost exclusively in commercial areas. In some regulations the permissible volume is phrased in terms of the volume of a prism, the base of which is equal to the area of the lot and the height of which is based on a specific number of feet or a multiple of the street width.[25]

The other regulations were more direct. They state that permissible volume equals the area of the lot times a specific number or a multiple of the street width. For example, the permissible cubical content of a building on a lot 100' x 100' facing a 60'-0" street, with height based on three times the street width, shall be 1,800,000 cubic feet distributable in any way so long as other regulations for

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[25] Ibid., p. 517.

light, air and open space were complied with.

The floor area ratio (F.A.R.) is one of the newest and most popular zoning techniques. It is based on the relationship between the floor space permitted in the building and the area of the lot. Thus, where the floor area ratio is 1:1, the maximum permitted floor area on a 100' x 100' lot would be 10,000 square feet. Assuming no daylighting or open space regulations, a builder could construct a one-storey building covering the whole lot, a two-storey building covering one-half the lot, or a four-storey building covering a quarter of the lot.

The simple and clear diagram (From A Plan to Combat Congestion in London, L.C.C. 1957) prepared by the L.C.C. Planning Department shows clearly what is meant by the floor ratio or sometimes called the Plot ratio (Fig. 11) The diagram shows four alternate ways of building on a site with three different ratios.[26]

In New York Zoning regulations it is described as:

"Floor area is the sum of the gross horizontal area of the several floors of a building, including interior balconies and mezzanines but excluding garage area and basement and cellar floor areas not devoted to residence use. All

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[26] Percy Johnson Marshall, Rebuilding Cities, University Press, Edinburgh, p.173.

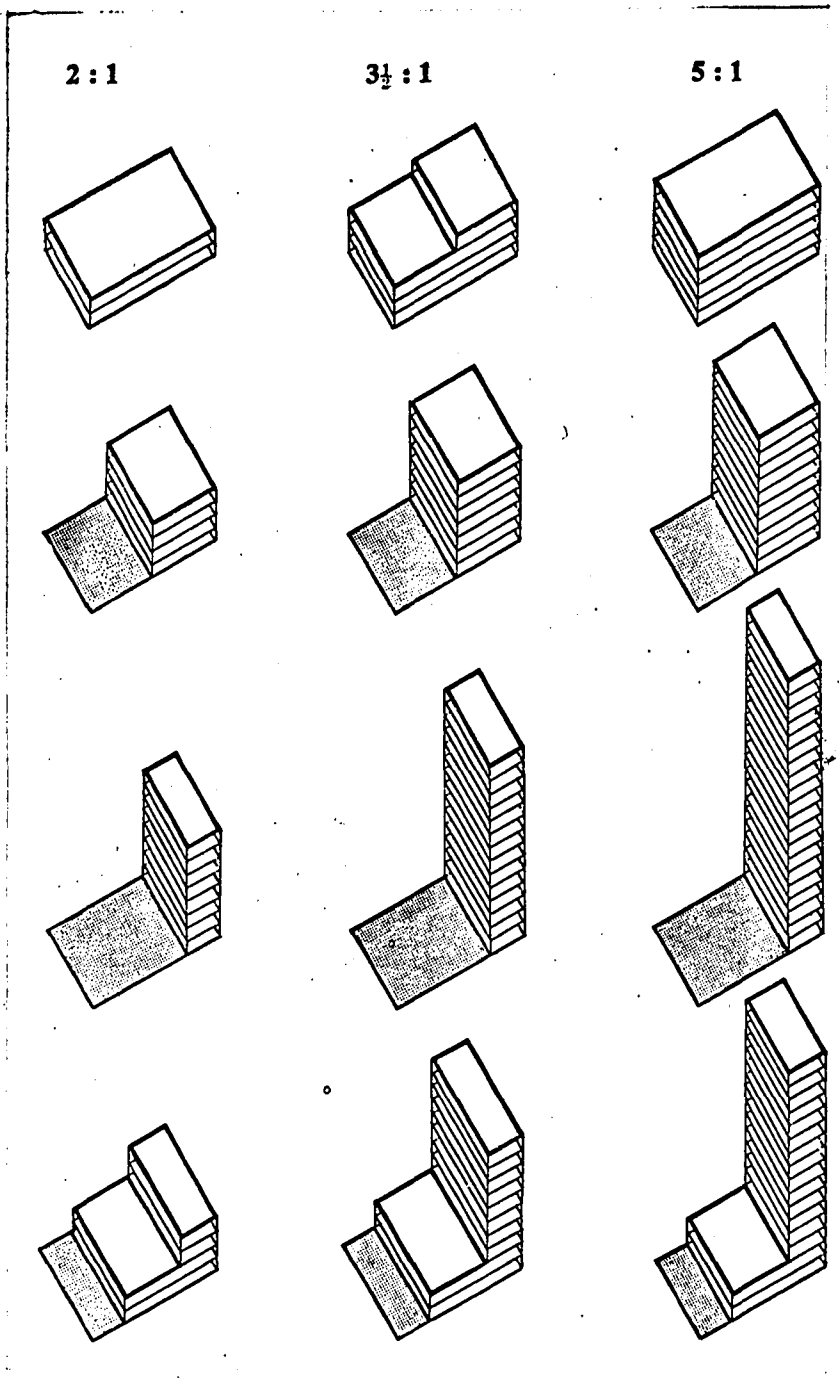

Fig. 11 PLOT RATIO EXPLAINED:

The relationship of lot area with the building bulk is indicated under three different ratios.

> horizontal dimensions are to be made between the exterior faces of walls, including the walls of roofed porches. The floor area of a building shall include the floor area of accessory buildings, except garages, on the same lot, which shall be measured in the same way.
>
> "These requirements cannot be regarded as purely a density control, since they permit greater floor area on corner lots than on interior lots. The differential is due to the carrying over of the influence of regulations designed to secure daylight rather than objectives of density."[27]

The floor area ratios, which vary greatly, are an accurate indication of size: the Empire State Building, (Fig. 12) the world's tallest (102 storeys) has an F.A.R. of 25:1; A.T. & T. Headquarter in New York City (27 storeys) 24:1; Stuyvesant Town - the large-scale housing project in New York's residential district 3.13:1.[28]

Neither cubage nor the floor area ratio controls require a height limitation to achieve their purpose of controlling building size, although some cities have imposed

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[27] "Building Size, Shape & Placement Regulations", (extracts from foot-notes nos. 50 & 52), Yale Law Journal, March 1951, p. 518.

[28] Ibid., p. 518.

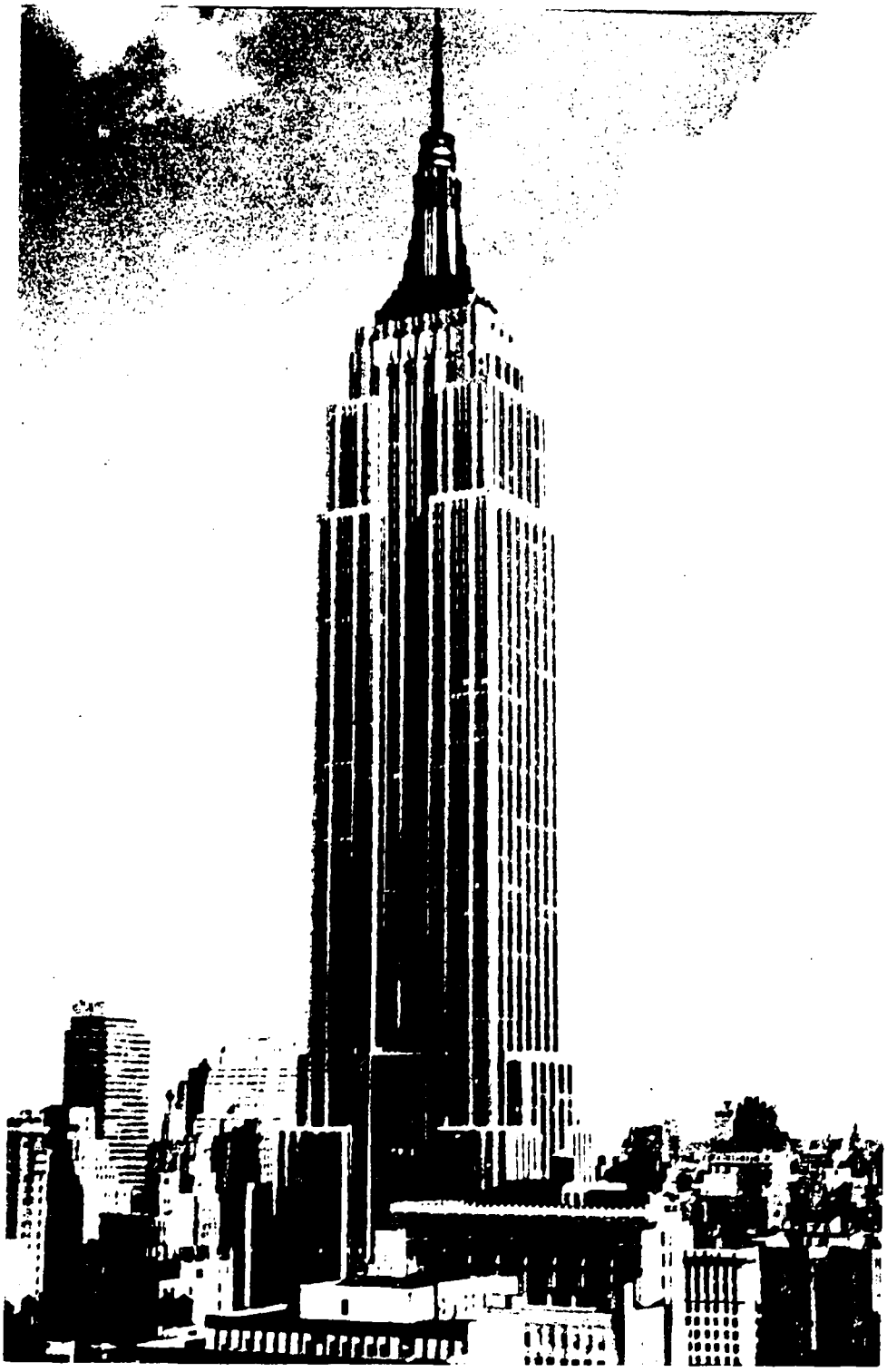

Fig. 12. NEW YORK: THE EMPIRE STATE BUILDING.

Erected in 1929, it is 1472 feet high (102 storeys) having a F. A. R. of 25:1.

SELECTED NEW YORK AND CHICAGO
BUILDINGS OF EXCEPTIONAL SIZE

Building	Completion Date	Number of Stories	Gross Floor Area (sq.ft.)	Floor Area Ratio
NEW YORK				
Empire State	1931	102	2,074,000	25.0:1
Pan Am	1964	59	3,000,000	18.6:1
World Trade Center (group of buildings)	1970	5 to 110	12,000,000	17.2:1
Chase Manhattan Bank	1961	60	1,860,000	15.8:1
Rockefeller Center (group of buildings)	1932-40	6 to 70	6,056,000	12.0:1
CHICAGO				
First National Bank	1969	60	2,000,000	17.5:1
Merchandise Mart	1929-30	22	4,000,000	14.5:1
Prudential	1955	41	1,763,000	10.2:1
Civic Center	1965	31	1,166,000	10.2:1

this as well. They apply to the intensity of of development. With the freedom of design achieved in these regulations it is possible to build very large buildings with relatively moderate floor area ratios depending, of course, on the size of the lot. The table on page 42 shows a comparative study of various buildings in New York and Chicago areas.[29]

The floor area ratio has two distinct advantages over cubage regulations. The latter tend to encourage lower ceilings in order to achieve maximum usable floor space. The F.A.R. on the other hand permits the architect to set ceilings at the optimum height. Secondly, the floor area ratio is phrased in terms of square feet which the architect and builder are accustomed to using, in their daily practice.

2. Daylight Controls:

Even if adequate controls over density are adopted, additional controls over daylighting are necessary. Neither the floor area and cubage limitations, nor lot area requirements regulate the placement of buildings on the land. If no further controls were adopted buildings could be placed indiscriminately on lot lines in such a way as to interfere with the light and air on the neighbouring lots.

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[29] City Planning Commission, San Francisco Downtown Zoning Study, C-3 & Adjacent Districts; Final Report: December 1966; p. 19.

There has been little change in the techniques regulating daylighting of buildings since the first zoning ordinances. In high-density commercial areas the only protection against dark streets is the height and set-back requirements, already discussed under density controls. As daylighting controls, they are direct and workable. The only disadvantage is that they tend to guide the architectural expression. In areas where a builder desires to build up to the permitted maximum, the zoning ordinance rather than the architect designs the building.

> "Legislative regulation of buildings as contained in building codes, zoning and other ordinances designed to protect the health, safety and general welfare of society are one of the severest limitations under which design must operate. The severity lies in the rigidity, and not in the legitimate purposes."[30]

In addition, construction costs are increased by the necessity of complying with set-back requirements.

Regulations have even been based on 'angles of light' in which a line is drawn at some angle such as 45 degree from a given point; i.e. the centre of the street towards the building which is to be restricted. The building can not extend above this line. However, these requirements accomplish the same results as a set-back

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[30] Vermilya, "The Need for Research", in Creighton Building for Modern Man 38 (1949), cited in "Building Size, Shape & Placement Regulations". (note no. 56), Yale Law Journal, March 1951, p. 520.

technique, and, like it, is a severe restriction on architectural expression. In order to give more design freedom, the angle of light might be averaged over the front of the building so as to permit one portion of the building to extend above the line, if the other part was correspondingly lower.

A further refinement of daylight controls has been developed for use in replanning the City of London, which are discussed in detail in Chapter No. 3. The standard for measuring the amount of daylight in buildings called the daylight factor was set up. This factor is based on a ratio between the daylight available in the building and that available under an unobstructed sky. The daylight indicators developed are used to check whether the required daylight factor in the proposed buildings has been met.

This method seems preferable to all devices now employed in North America. In recognizing the principle that light may reach a window not only over the top of a facing building, but also past the side of it, the London method gives the builder much greater freedom in placing his buildings on the lot and permit new architectural forms not possible under existing ordinances.

3. Open Space:

These regulations were initially designed only for residential

districts in order to ensure adequate open space for rest, recreation, and some measure of privacy. Until recently, open space has been largely a by-product of light and air regulations; i.e. yard requirements have usually provided the only required open space. But this has not been very satisfactory since neither adequate density nor daylighting controls necessarily ensure sufficient open space.

The coverage regulation prescribing the percentage of the lot which may be covered by the building does not provide an acceptable solution.

> "Among the cities to adopt coverage regulations are New York (coverage ranging from 35% to 90%), Chicago (coverage ranging from 35% to 60%) and Seattle (coverage ranging from 35% to 90%). The proposed San Francisco ordinance also has a coverage requirement in residential areas with coverage ranging from 40% to 45%.
>
> "Coverage in Federal, State and City housing projects has run about 28% - 30% while private builders in Park Avenue slum area maintain coverage of about 80%."[31]

But since this regulation may permit the open area to contain necessary buildings and parking areas, it leaves narrow strips of open space which are not suitable for any purpose. Moreover, in most cities the unit of open space does not depend on the number of persons in the building. To meet these two disadvantages an open

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[31] "Building Size, Shape & Placement Regulations", (foot-note no. 66), Yale Law Journal, March 1951, p. 523.

space regulation has to be based on the minimum amount of usable space for each family or dwelling unit.

Recognizing the above fact the Harrison, Ballard and Allen report in 1950 (Plan for Rezoning) suggested still another bulk control. This device was labelled "Usable Open Space". The outdoor recreation space was required to be related directly to the number of people using it, and not to a by-product of other controls.

In the higher density districts there was provision for the substitution of balcony and roof space for ground-level space under specified conditions.

Some cities have attempted to provide open space by the use of yard requirements (e. g. Allan Town Zoning Ordinance) which increases the side yards on the basis of the number of families in the building.[32] This is not very desirable as it tends to cut the open space in small fragments.

Philadelphia and Rye Zoning ordinances lay down the following open space requirements:

> "Multiple dwelling shall have a minimum rear yard area of 368 square feet, and shall have an additional 100 square feet of rear yard for each additional family more than three families."[33]

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[32] Ibid., (extract from foot-note no. 66)

[33] Ibid., (extract from foot-note no. 67)

"Open space provision: Included in every lot used in whole or in part for residence there shall be a total area allotted to outdoor recreational use equal to at least 500 square feet per family, except that this may be reduced to 300 square feet per family in a Residence or a Business District."[34]

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[34] Ibid., (extract from foot-note no. 68)

RECENT DEVELOPMENTS:

Recent years have seen further refinements of bulk control regulations of some major North American cities, which are keeping with the modern trends and changing concepts of urban environment. To promote architectural flexibility while avoiding obstacles to air and light, the floor area, open space, density regulations and the conventional set-back requirements of New York which produced the familiar stepped shapes, were modified by the adoption of "Sky exposure plane" for commercial zones, and the "Open Space Ratio" for multi-family residential districts.[35] The effect of these provisions in combination with the inducements of increases permissible for floor space in proportion to the open space reserved at the ground level is comparable to the F. A. R. method of regulations, and at the same time ensures the required daylight and open space standards (Fig. 13).

Sky exposure plane is described as follows:

> "The ordinance specifies the fixed maximum height at the property line for each zone and street width. Above this height the receding SEP controls the building setback. This volume control is amplified by the "bonus" of additional permitted floor space as compensation for building setbacks at the street level. The angle of declination of the SEP rises more sharply from the fixed building height in proportion to the building setback, thus increasing the permitted height and floor area."

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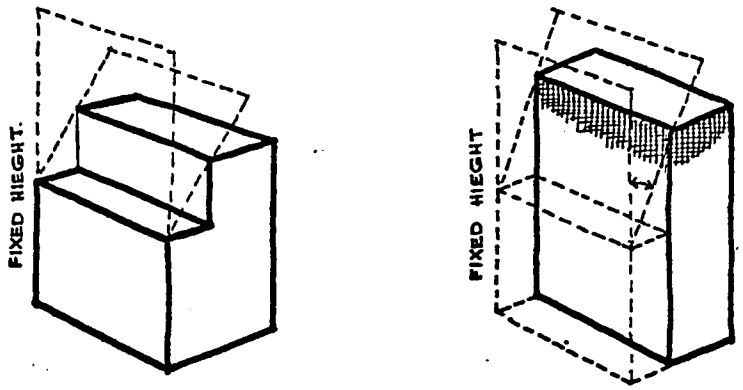
[35] Gallion & Eisner, The Urban Pattern, p.

[36] Ibid., p. 215.

SKY EXPOSURE PLANE (SEP)



OPEN SPACE RATIO (OSR)

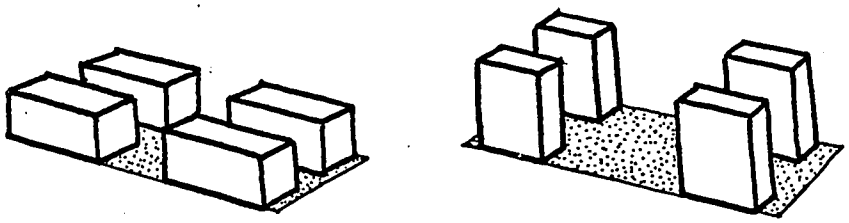


FIG. 13.

'Bonus' or 'Premium':

The floor area ratio in some of the cities now includes the element of 'bonus' or 'premium' space. This additional space allowance is used to encourage certain building features producing public benefits.

Chicago adopted such inducement in its revised ordinance of 1957 (Fig. 14) and later followed in Washington, D. C., Philadelphia, Detroit, Baltimore and in fact, they have now found their place in the zoning regulations of most of the major cities in North America. Their relative position up to 1965 can be compared in the bulk control regulations of various cities given at the end of this chapter.

Establishment of Purposes for the Bonus System:

The aim and object for offering bonus system in San Francisco Zoning Study are given below.[37] The same are, in general, applicable to most of the cities where such system has been adopted.

1. Good access to building and improvement of access to other properties in the area, from the various means of transportation feeding the downtown area.

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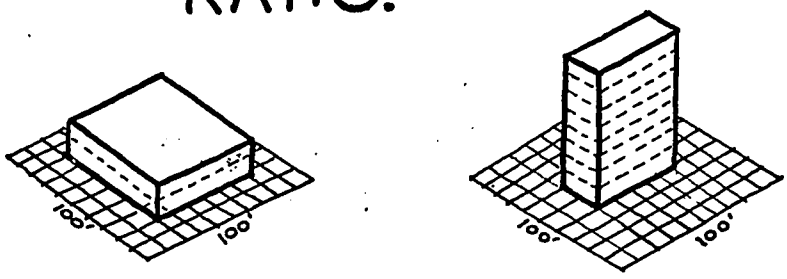
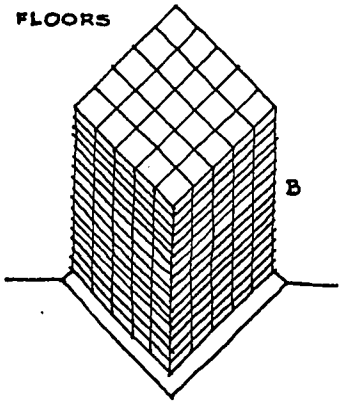
[37] City Planning Commission, San Francisco Downtown Zoning Study, Final Report: December 1966, p. 21.

FIG. 14. THE FLOOR AREA RATIO.

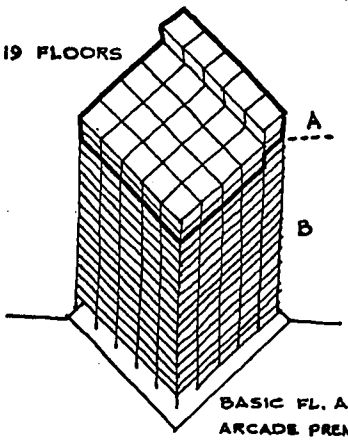


16 FLOORS



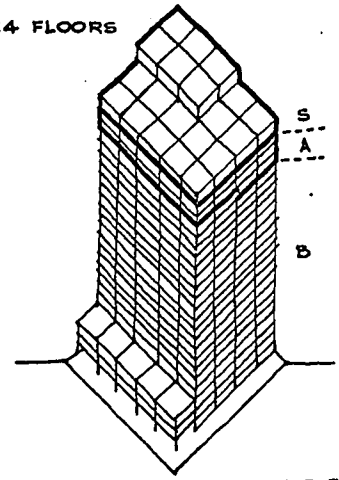
BASIC FLOOR AREA: 160,000 SFT.

19 FLOORS



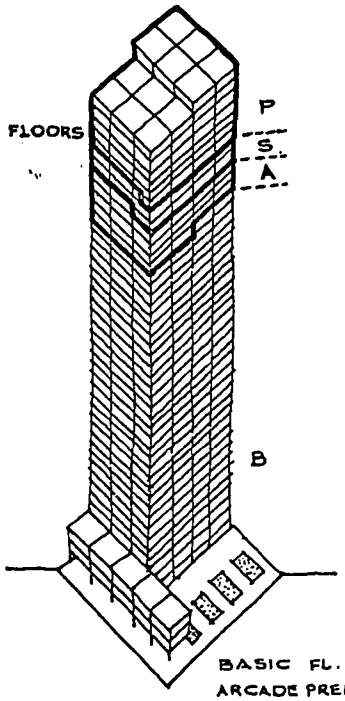
BASIC FL. AREA: 160,000 SFT.
ARCADE PREMIUM: 20,000 SFT.
TOTAL. FL. AREA: 180,000 SFT.

24 FLOORS



BASIC FL. AREA: 160,000 SFT.
ARCADE PREMIUM: 20,000 SFT.
SETBACK PREMIUM: 10,400 SFT.
TOTAL FL. AREA: 190,400 SFT.

45 FLOORS



BASIC FL. AREA: 160,000 SFT.
ARCADE PREMIUM: 20,000 SFT.
SETBACK PREMIUM: 10,400 SFT.
PLAZA PREMIUM: 27,200 SFT.
TOTAL FL. AREA: 217,600 SFT.

2. Improvement of pedestrian movement into the building, along the street and between streets.

3. Provision of pedestrian amenity by means of ground level open space.

4. Arrangement of the building so as to provide light and air to streets.

5. Protection and enhancement of views.

Under these purposes most bonus features provided by the developer could be expected to be found at one of three locations: either at ground level around the base of the building, just above or below ground level where movement of persons could be facilitated without the use of streets or at upper levels where there would be certain effects upon the shape of the building. In some cases also, a premium might be awarded based on the location of the new buildings, since location with the best accessibility may be appropriate for higher intensities of development.

"Selection of Bonus Features:[38]

The requirements for 'bonus' or 'premium' areas are liable to differ between various cities, depending on their individual circumstance and direction of growth. However, the considerations

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[38] Ibid., p. 22-23.

for such allowances in San Francisco report of December 1966[38] seems quite comprehensive, and cover most of the critical problems of high density areas. These are:

Accessibility:

1. Rapid transit access: directly from the site to the mezzanine of a regional or city transit station, with this access constructed by the owner on private property, clearly marked and open to the general public during normal business hours.

2. Rapid transit proximity: for sites other than those having direct rapid transit access, with the largest bonus (a location premium, in this case) given for sites adjacent to the station mezzanine and a lesser bonus given as walking distance increases, up to a maximum distance of 750 feet.

3. Parking access: as a direct pedestrian link from the building to a parking structure provided on the same site or adjacent to it, if

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[38] Ibid., p. 22-23

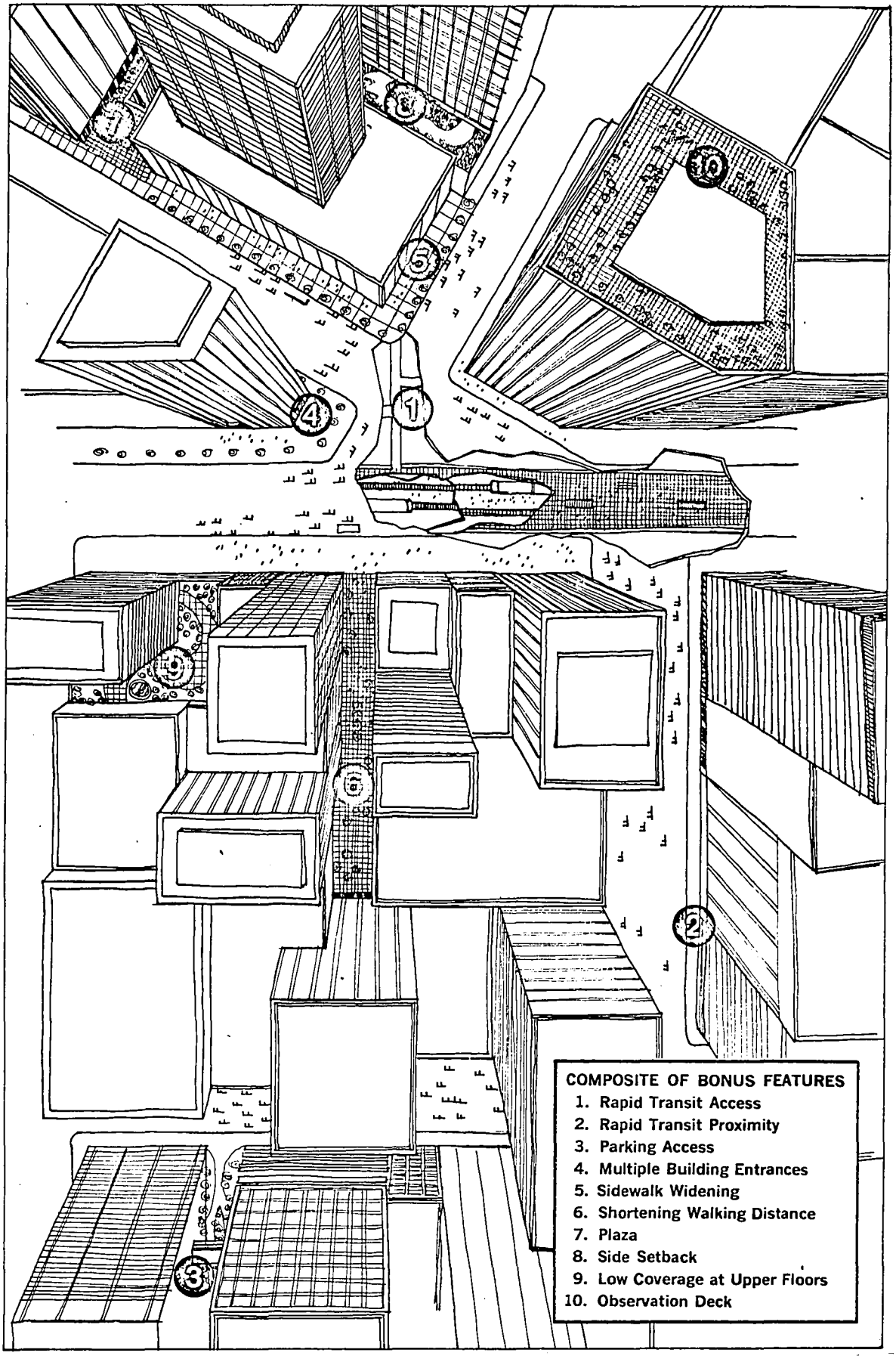
COMPOSITE OF BONUS FEATURES
1. Rapid Transit Access
2. Rapid Transit Proximity
3. Parking Access
4. Multiple Building Entrances
5. Sidewalk Widening
6. Shortening Walking Distance
7. Plaza
8. Side Setback
9. Low Coverage at Upper Floors
10. Observation Deck

FIG. 15

the parking is located elsewhere than in the area of concentrated development of the office and retail districts.

Pedestrian Movement:

4. Multiple building entrances: at least 50 feet apart, connecting to the same street or to different streets, to reduce in size the interruptions to sidewalk movement caused by large numbers of persons entering and leaving a building at any one point.

5. Sidewalk widening: inside the property line for the full width of the building, by means of an arcade, cantilever, plaza or setback, to allow additional width for pedestrian movement along the street. The amount of bonus would increase with the width of the arcade or other feature, up to a maximum of 30 feet of creditable width on private property.

6. Shortening walking distance: from one public street to another, by use of a plaza, arcade, setback or passageway inside or outside the

building, open during normal business hours, to relieve sidewalk congestion and add to pedestrian convenience. The amount of bonus would be proportional to the amount by which the walking distance between street was shortened.

Pedestrian Amenity:

7. A plaza: beyond the depth from the street at which a sidewalk widening is credited, accessible to the general public from a street or passageway and serving as a rest area and ground-level open space with a minimum horizontal dimension of 30 feet. Up to two-thirds of the plaza area could be occupied by benches, planting and other such features.

Light and Air to Streets:

8. A side setback: of the building, beginning at or below a height of 40 feet above the street and extending the full depth of the lot. The bonus would increase in proportion to the width of the setback, from a minimum width

of 20 feet up to a maximum of 50 feet. This bonus would not apply to a setback at the front or rear of a building, where the opportunities for light and air penetration to both the street and adjacent properties are not as great as at the side of the building.

9. Low coverage at upper floors: above a height of 80 feet, permitting light and air penetration, with the exact shape and siting of the building to be determined by the developer. This bonus would be an alternative to the side setback bonus, and would be given where the upper floors were set back at least 20 per cent of both lot dimensions, increasing as the setbacks increased up to a maximum of 50 per cent of both lot dimensions.

View Protection and Enhancement:

The feature listed as Item No. 9 would also provide a limited type of view protection, since the effect would be to encourage slender towers spaced a certain distance apart, and these towers would be less of an interruption

to views than more massive structures placed closer together. More direct measures for control over the shape of buildings at upper floors were considered in the study but rejected as impractical.

10. An observation deck: or other public space provided at a height of at least 20 storeys above street level, at which the view from the building could be made accessible to the general public during daytime and evening hours. (In addition to the floor area bonus, a further incentive would be given by excluding this space in computing the gross floor area of the building for floor area ratio purposes.)

QUANTITY OF BONUS FLOOR AREA FOR EACH BUILDING FEATURE PROVIDED

Building Feature		Unit of Feature Upon Which Bonus Is Based	Square Feet of Bonus Floor Area Per Unit of Feature				Maximum for This Bonus (Per Cent of Basic Allowable Gross Floor Area)
			Downtown Office District	Downtown Retail District	Downtown General Commercial District	Downtown Support District	
1. Rapid Transit Access	Larger of these two bonuses applies	Provision of direct access to station mezzanine	20% of basic allowable gross floor area (⅕ less if station is for city transit only)				20
2. Rapid Transit Proximity		Each linear foot by which walking distance to station mezzanine is less than 750 feet	50	40	40	40	10
			(⅕ less if station is for city transit only)				
3. Parking Access		Each automobile parking space to which direct access is provided	100	100	100	100	5
4. Multiple Building Entrances		Each principal entrance to the building after the first entrance	10,000	10,000	7,000	5,000	5 (or one entrance, whichever is greater)
5. Sidewalk widening		Each creditable square foot of sidewalk widening area	7	7	6	4	15
6. Shortening Walking Distance		Each linear foot by which walking distance between streets is shortened	40	40	40	30	10
7. Plaza		Each creditable square foot of plaza area	10	8	8	6	15
8. Side Setback	Larger of these two bonuses applies	Each creditable square foot of side setback area	6	6	6	3	15
9. Low Coverage at Upper Floors		Reduction of both building dimensions by 20% or more of the lot dimensions	5% of basic allowable gross floor area for the first 20% reduction of building dimensions; 1% for each 3% reduction thereafter				15
10. Observation Deck		Provision of observation deck or similar high-level public space	10,000	10,000	10,000	10,000	Not Applicable

Development Rights Transfer:

Another important recommendation in the San Francisco Zoning Study was the permission for transfering the development rights between properties. In such a case, a developer could acquire from an adjacent owner or from an owner of property across the street, unused floor area on the other parcel equivalent to the difference between the existing floor area permitted for that parcel under the applicable basic floor area ratio limit.

This type of transfer, usually not permitted under the F.A.R. provisions, was felt to have advantage in San Francisco, in contributing flexibility to the action of owners in a given block. This was specifically recommended for the central district where the need for such transfer is more critical.[39]

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[39] Ibid., p. 27.

BULK CONTROL REGULATIONS:

Provision of bulk controls for high-density areas in the following cities of North America are described, which affords an interesting comparison of such developments in these places:

1. Boston (proposed 1958)
2. Chicago (1957)
3. Cleveland (1956)
4. Detroit (1940: amended to 1961)
5. District of Columbia (1958: amended to 1962)
6. Los Angeles (1955)
7. Minneapolis (proposed 1960)
8. New York (1963)
9. Philadelphia (1962)
10. Montreal (1948: amended to 1967)

BOSTON[40]
(proposed 1958) Metro. Pop: 2,589,301.

F.A.R.: 10.0

Premiums:

a) A 10% increase in F.A.R. is allowed for each parking space which is provided for 10 dwelling units.

b) For a lot abutting a street or a public open space more than 100 feet wide, one-quarter of the excess over one hundred feet, up to forty feet, may be added to the lot depth in calculating the F.A.R., provided the F.A.R. as calculated normally does not exceed 12.00.

c) If both exemptions apply, the maximum F.A.R. is 14.0.

Set-Back: Not less than (H + L)/8.

Front Yard: If lot abutting a residential district the set-back to be guided by abutting district.

Rear Yard: 10' + L/20. Maximum 20'0"

Side Yard: No requirement.

Closed Court: For purpose of light and ventilation, the width to be greater than height and length greater than twice width.

Open Court: For purpose of light and ventilation length to be less than or equal to average height; width greater than half length.

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40 Aspo Planning Advisory Service, CBD Zoning Controls in Selected Cities: Information Report No. 80: November 1963, p. 2, 5.

CHICAGO:[41]
(1957) Metro. Pop: 6,220,913.

F.A.R.: 16.0.

Premiums:

a) If adjoining public open space:

(i) Where the front or side lot line adjoins a a public open space of at least 5 acres with a depth of at least 200 feet perpendicular to the lot line the F.A.R. may be increased 15%.

b) For set-backs:

(i) If first storey along a front lot line is set back from a street at least 20 feet, a premium of 2.0 may be added provided the area is suitably paved or landscaped. If all storeys are set back at least 20 feet, the premium is 2.5.

(ii) If all storeys are set back at least eight feet along one or more lot lines, a premium of $2\frac{1}{2}$ times the open area divided by the gross lot area may be added.

(iii) For all storeys above the ground floor set back at least eight feet from one or more lot lines, a premium equal to 0.4 times the open area of the lot at the level of such floor divided by the gross area may be added.

Set-Backs: No requirements.

Closed Courts: No requirements.

Open Courts: No requirements.

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[41] Ibid., p. 2, 6.

CLEVELAND:[42]
(1956) Metro. Pop: 1,796,595.

F.A.R.

Res: 1.5.
Com: No requirement.

Height:

Res: The height limit = 3 D but less than 115': Set-back additional foot of height = 1/3';

Maximum height = 175' except towers, in which case maximum lot coverage is 25% and the tower to be minimum 25' from any side lot line.

Com: The height limit = 5 D but less than 115': Set-back additional foot of height = 1/5';

Maximum = 375' except towers as mentioned in above paragraph.

Set-Backs:

- Front Yard:
  Res: 15% of average lot depth on block or 30', whichever is less.

  Com: No requirement.

- Rear Yard:
  Res: 15% of lot depth, $\frac{1}{2}$ building height, or 20', whichever is greater.

  Com: 3'' /ft. of building height or 5', whichever is greater.

- Side Yard:
  Res: $\frac{1}{4}$ building height or 8', whichever is greater.

  Where the length of the building parallel to an interior side lot line is greater than

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42 Ibid., p. 2, 6-7.

CLEVELAND: Continued

40', the area of that part of the side yard abutting the building must exceed the product of 1/3 the height of the building and the length of the buildings parallel to the lot line. When the side yard provides all the light, and air for all the habitable rooms of one dwelling unit, the area of that part of the interior side yard abutting the building side wall must exceed the product of $\frac{1}{2}$ the building height and the length of the building along the side yard. The area of courts opening on side yards may be used to satisfy the above requirement.

Com: 3" /ft. of building height or 5', whichever is greater.

Closed Courts: Res: Width greater than or equal to 1 ft./ft. of building height or 10', whichever is greater. For other purposes the width to be 3' /ft. of court height at that level or 5', whichever is greater.

Com: Width greater than or equal to 3" /ft. of building height or 5', whichever is greater; area greater than or equal to $1\frac{1}{2}$ times square of width.

Open Courts: Res: For purposes of light and ventilation, width greater than or equal to 4" /ft. of building height or 10', whichever is greater. Area less than or equal to 3 x square of width (whereas width cannot be less than 1/3 of length).

Com: Width greater than or equal to 3" /ft. of building height or 5' whichever is greater. Area less than or equal to 3 x square of width (whereas width cannot be less than 1/3 of length).

DETROIT:[43]
(1940: amended to 1961) Metro. Pop: 3,762,360.

F.A.R. No requirement.

Maximum Bulk: Volume of prismoid of height = 3 x maximum abutting street width. (Base = lot area) except that:

a) Street width measurement in the maximum bulk calculation may not exceed 150 feet, and

b) A tower may be built whose horizontal section is never more than 60'x 60' or 25% of lot area, whichever is less; and whose nearest wall is more than 30 feet from every lot line and 60 feet from any other tower on the same structure.

Set-Backs: No requirement.

Closed Courts: No requirement.

Open Courts: No requirements.

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[43] Ibid., p. 2, 8.

DISTRICT OF COLUMBIA:[44]
(1958: amended to 1960) Metro. Pop: 2,001,897.

F.A.R.

Res: 5.5
Com: 8.5 (Maximum 10.00)

Premium:

1. Additional F.A.R. allowances of .12 and 1.0 are allowed for roof-top accessories and off-street parking, respectively. The off-street parking premium does not apply to residential uses other than hotels.

2. The height limit may be extended to 130' (and the F.A.R. to 10.0 for non-residential uses) if the building faces a street greater than 110' wide and if such a building which abuts a residence district is set back 6" for each foot of height above 110' along the lot line abutting that district.

Height:

110'. May be extended to 130' if the building faces a street.

Maximum Lot Coverage:

Less than or equal to 75% which includes:

a) Side yards and open courts less than 5' wide.
b) Closed courts less than 6' wide.

Set-Backs:

Front yard:
No requirement.

Rear Yard:
3"/ft. of building height with a minimum of 12'.

Side Yard:
No requirement.

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[44] Ibid., p. 3, 8-9.

DISTRICT OF COLUMBIA continued

Closed Courts:	Res:	Width greater than or equal to 4" /ft. of court height; minimum 15', and area greater than or equal to 2 x square of width; min. 350 square feet.
	Com:	Width greater than or equal to $2\frac{1}{2}$" /ft. of court height., min. 12'. Area greater than or equal to 2 x square of width; minimum 350 square feet.
Open Courts:	Res:	Width greater than or equal to 3" /ft. of court height; minimum 10'.
	Com:	Width greater than or equal to $2\frac{1}{2}$" /ft. of court height, minimum 6 feet.

LOS ANGELES:[45]
(1955) Metro. Pop: 6,742,696.

F.A.R. Varies according to district. Max. 13.0.

Maximum Height: 13 storeys or 150 feet, whichever is less.

Set-Backs:

Front Yard: No requirement.

Rear Yard:

Res: 25% of lot depth up to 25 feet + 1'/storey from 3 to 8 storeys.

Com: No requirement.

Side Yard:

Res: 3' - 5' if less than $2\frac{1}{2}$ storeys + 1'/storey over 2.

Com: No requirement.

Closed Courts: No requirement.

Open Courts: No requirement.

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[45] Ibid., p. 3, 9.

MINNEAPOLIS:[46]
(Proposed 1960) Metro. Pop: 1,482.030.

F.A.R.

Res: 14.0 (max. 30.1)
Com: 14.0 (max. 32.1)

Presmiums:

a) A 15% public park premium is permitted where a building lot fronts a public open space more than 200' deep and 5 acres in extent.

b) A premium of 2.0 is added to F.A.R. where a sidewalk canopy is provided.

c) Premiums are permitted for either an external arcade or a plaza. An arcade premium of 6.0 is permitted where a building is set back at least 20 feet from the front lot line; the premium increases as the open movement area increases from 6' to 18' in depth. Plazas, for which the premium is 8.0, must be open to the sky except for weather protection. They must be open to the pedestrian movement and consist either of an area of 7,500 square feet or 1/6 of lot area, whichever is greater, with full building frontage, or of an area of 7,500 square feet with a 50 foot frontage.

Height: No requirement.

Set-Backs: Front yard: No requirement.

Rear yard: No requirement.

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[46] Ibid., p. 3, 9-10.

MINNEAPOLIS: continued

Side yard: Com: 5' or 1/5 building height, whichever is greater. If the building is greater than 50 feet wide, the requirement is 10% of the width or 20% of the height, whichever is greater.

Closed Courts: No requirement.

Open Courts: No requirement.

NEW YORK:[47]

(1963) Metro. Pop: 10,694,633.

F. A. R. Res: 10.0 (Max. 12.0)

Premiums:

a) 6 square feet extra area for each square foot of open plaza area which may consist of:

1. Continuous open space in front of minimum 50 foot length, 10 foot depth and total area: 750 square feet.

2. Continuous open space on a through lot of not less than 40 feet width.

3. An open area on a corner lot of minimum 500 square feet and minimum 10 feet wide.

4. An open area of minimum 8,000 square feet and minimum dimension of 80 feet and either located in front or connected to the street by arcade or open area of minimum 40 feet width.

b) 6 square feet for each square foot of open area as in a)4. above.

c) For each square foot of arcade an increase of 3 square feet is allowed.

Com: 15.0 (Max. 18.0)

Premiums:

a) Plaza: 10 square feet of additional gross floor for each square foot of plaza area.

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[47]Ibid., p. 4, 11-13.

NEW YORK: continued

b) Plaza connected open area: same as above.

c) Arcade: 3 square feet of additional gross floor area for each square foot of arcade area.

Maximum Height:

Res: 85 feet or 9 storeys, whichever is less; within setback distances plus 'Sky Exposure Plane'. The setbacks shall be 20 feet for buildings fronting on streets less than 75 feet wide; and 15 feet for streets more than 75 feet. The Sky Exposure Plane shall form on a horizontal line 85 feet above the street line inclined towards the lot at an angle in the ratio of 2.7:1 on a narrow street and 5.6:1 on a wide street.

Com: 85 feet or 6 storeys:
No restrictions on height limit if buildings are set back 15 feet from lots fronting on street less than 75 feet. The Sky Exposure Plane extends from a horizontal line 85 feet above street level forming an angle towards the lot in ratio of 3.7:1 on narrow streets and 7.6:1 for wide streets, which forms the height limit.

Towers: The buildings or part thereof may penetrate the S.E.P. provided the maximum cross sectional area of the tower is 50% for lots 10,500 square feet or less; proportionately reduces to 40% for lots 20,000 square feet or more. In addition, the tower should be set back at least 1/3 of street width for narrow streets and $\frac{1}{4}$ for wide streets to a maximum of 50 feet and 40 feet respectively.

Coverage: No requirement.

NEW YORK: continued

Setbacks:

1. Front Yard: No requirements.

2. Rear Yard: Res: 30 feet

No requirement for corner lots or through lots less than 110' deep. For lots greater than 110 feet the rear yard shall be equal to:

a) Two front yards of full lot width; minimum 30 feet.

b) Open area of 50 feet depth and full lot width joining two rear yards.

c) Open area for full lot depth along a side lot line, at least 60 feet wide at every point.

For buildings of more than 125 feet height, an additional depth of 20 feet is required.

The minimum distance from any legally required window is 30 feet. This is reduced to 20 feet for lots less than 10,000 square feet in area.

Com: 20 feet except there is no requirement for corner lot or through lot. The requirement is reduced by 1 foot for each foot by which the lot depth falls short of 70 feet.

3. Side Yard:

Res: Same requirement as in last paragraph of 2(c). When a side yard is provided, minimum width 8 feet.

Com: No requirement. If provided, minimum width 8 feet.

Closed Court: Res: Area equal to or greater than 1,200 square feet: minimum dimension greater than or equal to 30 feet or half the total height of the wall above the window sill height, whichever is greater, but not more than 60 feet.

NEW YORK: continued

Com: No requirement.

Open Court: Res: Narrow street: width greater than or equal to twice depth.
Wide street: width greater than or equal to depth, but not more than 60 feet.

Com: No requirement.

PHILADELPHIA:[48] (1962) Metro. Pop: 2,002,512.

F. A. R. 8.0

Premiums:

a) Front Yard area:

1. If building faces a street more than 60 feet wide, 5% increase in gross floor area is allowed per foot of street width over 60 feet.

2. If building faces a street more than 50 feet wide, 15 square feet of gross floor area is allowed per square foot of front yard, minimum 10 feet width.

3. If building faces a street less than 50 feet wide, 10 square feet of gross floor area is allowed as in 2) above.

b) For buildings not on through lots, 10 square feet of gross floor area is allowed for each square foot of rear yard area.

c) 7.5 square feet of gross floor area is allowed for each square foot of arcade area which is unobstructed and minimum 10 feet depth.

d) For each square foot other ground level open area a premium of 5 square feet is allowed.

e) For each square foot of structure which does not exceed 40 foot height, a premium of 5 square feet is allowed.

f) No open parking area is allowed for such computations.

Height: No requirement.

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[48] Ibid., p. 4, 14-15.

PHILADELPHIA: continued

Coverage:
- Res: For buildings less than 5 storeys high; 80% for internal lots and 90% for corner lots.
- Com: No requirement.

Setbacks:

Front Yard: No requirement.

Rear Yard:
- Res: In case there is no legally required window, minimum 8 feet; otherwise, 15 feet for every 5 storeys.
- Com: No requirement.

Side Yard:
- Res: Depth greater than or equal to half the height; or 8 feet for every 5 storeys in case any legally required window is opening onto it.
- Com: 5 feet for less than or equal to 5 storeys; 8 feet for greater than 5 storeys.

Closed Court:
- Res: Minimum 100 square feet if no windows open and used as only a vent shaft; otherwise, minimum 300 square feet and least dimension 8 feet. In case of windows, the width to be equal to or greater than height of facing wall.
- Com: Minimum dimension is 8 feet and minimum area 100 square feet.

Open Court:
- Res: For open court between wings of the same building whose walls contain windows, where the building is more than 35 feet high or 3 storeys, the minimum width is the depth of court plus 1/3 of height of building over 3 storeys or 35 feet. For open court not between wings of same building, whose walls

PHILADELPHIA: continued

contain windows, the wall must not be closer to the lot line than 8 feet for each 5 storeys of height.

Res. and Com: If there are no windows the width of the court must be at least 5 feet for a building of 5 storeys or less, and 8 feet for a building of more than 5 storeys. If between wings of the building, and the walls contain windows, the minimum width is 12 feet.

MONTREAL:[49] Metro.Pop: 2,489,967.
(1967) Bylaw Nos. 1900 & 3411

F.A.R. 12.00

Premiums:

Maximum area may be increased @ 6 square feet per square foot space on parcel of land provided it is:

1. Developed as a place or terrace open at all times to the public.

2. Made up of one or of several at a time of the areas described below:

   a) A continuous open area adjacent to a street of minimum length of 50 feet, depth of 10 feet, and a minimum area of 750 square feet.

   b) A continuous open area between one of the lateral lines of lot and the building of minimum width of 30 feet.

   c) An open area on the corner of two streets of minimum 500 square feet and minimum depth of 10 feet on each street.

   d) Interior open area of minimum 6,000 square feet with a minimum width of 60 feet and minimum vertical clearance of 12 feet, open at least on one side and for a width of at least 30 feet.

The above areas to be not more than 4 feet above grade at any point. The compulsory set-backs from streets are not considered for these premiums.

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[49] City of Montreal, Building Bylaw No. 1900 & No. 3411.

MONTREAL: continued

Maximum Height: 130 feet (maximum 160 feet)

Shall be within an outline drawn in a vertical plane perpendicular to the street line continued by a straight line inclined towards the interior of the property in proportion of 4:1. The height of vertical line shall be equal to:

a) Twice the width of the street to a maximum of 130 feet.

In case of buildings fronting on a street which separates it from a public open space, half the width of the space may be computed in the width of the street for the purpose of this bylaw, to a maximum of 160 feet.

The same shall apply in the rear except that the vertical line is drawn on the rear line of lot.

Towers: Unlimited height of the building is allowed if the maximum coverage of the lot is 35% on interior lots; 50% on corner lots and 60% on lots fronting on more than two streets, on park or public open space, provided that no portion of the building at upper level is nearer than 20 feet to any vertical line erected on boundaries of lot except those constituted by street lines.

Coverage: Res: 75% on interior lots
90% on corner lots

Com: 100%

Rear Yards: Minimum 10'-0" all along rear boundary; to be increased by 2'-6" for each storey above three. Space between two structures to be at least 24 feet.

MONTREAL: continued

Courts: Minimum width of 6'-6" increased by 2 feet for each storey in excess of two.

In case of side court, the increase may be 1'-0" for each storey in excess of two.

Inner Courts Enclosed on All Sides: Minimum 12'-0"; increased by 2 feet for each storey in excess of two; length to be minimum of $1\frac{1}{2}$ times the width.

Completely enclosed courts to have at least one air intake at ground floor level of minimum 1/10 the court area.

Chapter III

ELEMENTS INFLUENCING FORM and RELATIONSHIP OF STRUCTURES

The previous chapters have outlined the basic structure of the city, its growth, the need to control its form to ensure an efficient and aesthetically satisfying environment and the regulatory controls which have been formulated to achieve these ends. This chapter shall discuss the various elements which play a dominent role in shaping our environment, and the progress made so far in evolving suitable methods for use in urban design.

The free enterprise system which has brought about the redevelopment and enlargement of the commercial buildings, had forced objective approach to building controls. The beginning of the twentieth century saw large buildings overshadowing their neighbours - thus denying them their rights of daylight and sunlight. The controls, therefore, gradually evolved into requirements of simple angles of light so as to ensure its equal distribution to all properties at all levels. Safeguarding adequate light and air was basic to public health and such control being in public interest were within the scope of State Enabling Act for Zoning.

The need to base such controls on scientific principles has led to extensive research on the subjects of daylight and sunlight which is discussed in the following study. The principles evolved, however, have not found favour in the North American cities due to their complicated nature and difficulties of application.

The other elements which are comparatively in the background but nevertheless important in determining the relationship and volume of structures are urban microclimate, fire-fighting and minimum open space around buildings which are also discussed briefly. However, proper research in these fields is still lacking, and related controls, if any, are based on empirical observations.

DAYLIGHTING:

The F. S. I. was formally controlled by prescribing maximum building height, but is now tending to be superseded by linking the floor space index with a system of daylight controls, as this ensures better lighting and gives greater flexibility in design. The current trend in offices, however, is towards comprehensive design of windows and permanent supplementary artificial lighting so as to obtain the best working conditions, at all times of the day. This is an unsatisfactory solution to the problem, and there is evidence that good natural light is a necessity for human comfort. The employment of methods to get daylight was to ensure that everyone can see outside sufficiently to have a feeling of working in daylight even if much of the working light came from an artificial source. The daylight indicators developed in London were designed to enable this to be done in an economical way.

The first attempt to link the daylight factor with the form and arrangement of buildings in an urban setting was done by William Allen and D. Crompton in their joint paper entitled "A Form of Control of Building Development in Terms of Daylight" in 1947.[50] It dealt comprehensively with the various problems connected with the development of high density areas.

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[50] R.I.B.A. Journal: August 1947; p.492 - 499

These recommendations were based on a certain percentage of sky factor applicable to all the windows in a building, and the daylight factor was computed as a ratio between the area of visible sky and double the extent of daylight through a window. For the purpose of generalization and comparative analysis, 50% of the external wall area was assumed to consist of window openings. Also, the desirable standard of daylight factor was taken as 1% at a distance of 12'-0" from the external wall. It was established that important differences in daylighting are associated with various forms and arrangement of buildings. An informal layout in a given area was proved to afford greater percentage of daylight as compared to a formal one. (Fig. 16)

The methods involved the extensive use of the Waldram diagram [51] for computing the daylight and sky factors, and introduced protractors or indicators to show the permitted height of buildings at any point in relation to selected pair of angular restrictions. Even though the indicators were not designed to achieve uniform standard illumination in practical application, they did ensure a certain minimum.

With the introduction of the above methods, it was possible to control the development of structures in high density areas

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[51] A Method Developed to Determine "Sky Component of the Daylight", by P. J. Waldram: Proc. International Illumination Congress, 1931. Vol. II, p. 1117. cited in R.I.B.A. Journal, August 1947, p. 499.

while ensuring sufficient space around them for daylight, as well as circulation and other exterior needs. The protractor developed was only applicable for comparatively small lots with definable boundaries, and not for large open sites since there were no boundaries between different blocks of the same scheme. (Fig. 17)

Subsequent development of such methods was introduced by L. C. C.'s Development plan of 1951[52], which ensured that every building would receive an adequate amount of daylight to all its external surfaces, and hence internal accommodation. It was a simplification, for general use, of a complex scientific problem. These methods are most useful when applied to large buildings and unconventional forms in high density areas or in town centres where coordinated development of various properties is desperately needed.

The above methods were further refined and consolidated by Ministry of Housing and Local Government in 1964[53] for general application, which are summarized in the following pages.

Purpose and Scope of Daylight Indicators:[54]

1. To provide a simple method for ensuring that at the layout stage buildings are so spaced that they respect the light of other buildings, and allow for recommended standards

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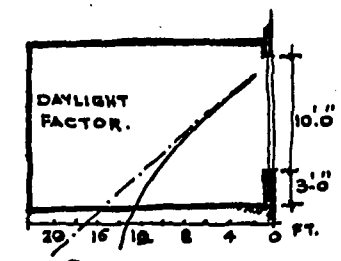
[52] Johnson - Marshall, Rebuilding Cities, p. 173.

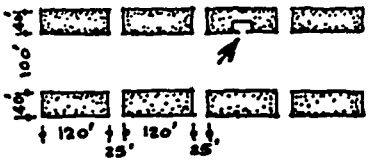
[53] Ministry of Housing and Local Government, Planning for Daylight and Sunlight: Planning Bulletin No. 5, H.M.S.O. London. 1964.

[54] Ibid., p. 4.

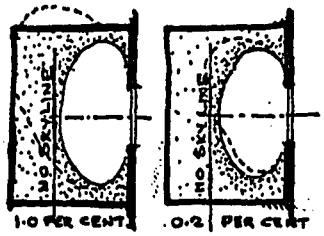
FIG. 16. DAYLIGHT & SKY FACTOR ANALYSIS:



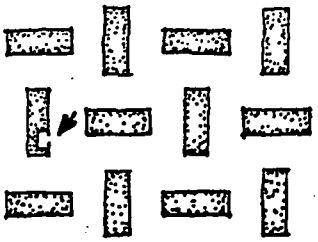
LAYOUT ① LAYOUT ①
PENETRATION CURVES



LAYOUT ①

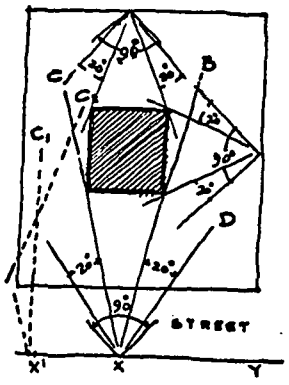


DAYLIGHT FACTOR CONTOURS.
LAYOUT ② LAYOUT ①

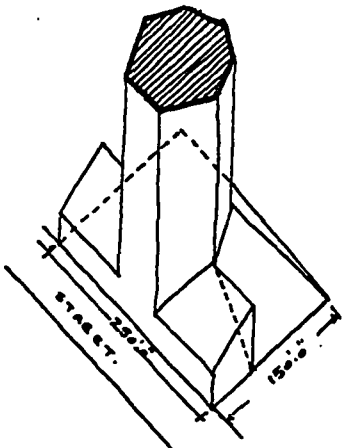


LAYOUT ②

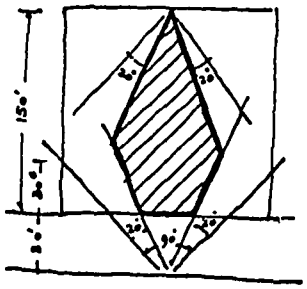
FIG. 17. COMPUTATION OF FORM & SPACE.



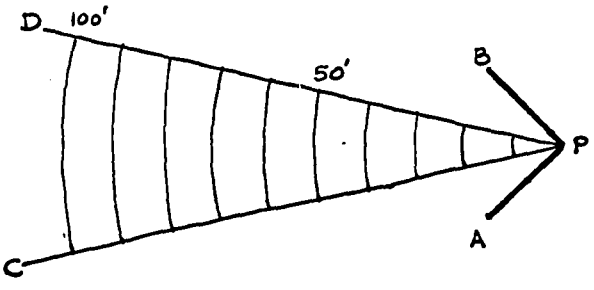
SKY EXPOSURE OF ADJOINING SITES.



BUILDING ENVELOPE BY ANGULAR RESTRICTIONS.



AN EXAMPLE DEVELOPMENT.



TYPICAL PROTRACTOR

of daylighting to be attained within them.

2. The methods are of value both to architects at various stages of work and to planning authorities in examining building layouts and design.

3. The daylight indicator can help the architect in relating the height and bulk of one building to another.

4. The planning authorities can ensure that new building is sited in such a way that it does not interfere with the reasonable daylighting needs of adjoining land; a new building must be a good neighbour and give others a chance to see the sky.

5. In addition to safeguarding the daylight of adjacent sites, the planning authority can see the relationship of one building to another within any layout.

Basis of System of Indicators:[55]

The system of indicators is based on the principle that the patch of sky seen at a particular point inside, say, an office, and large enough to give the standard of direct daylighting (Sky Factor) appropriate for office use can be of a wide variety of shapes. The

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[55]Ibid., p. 6.

sky may, for instance, be seen over a fairly high building of uniform height on the other side of the road; the patch of sky seen between the top of the building and the lintel of the window would then be of the full width of the window but quite shallow. (Fig. 18A)

At the other extreme, the sky may be seen at the side of a very tall building rising up behind or alongside a low one (Fig. 18B).

Four Sets of Indicators:[56]

Within the above latitude, various forms and shapes of buildings can be developed while using the indicators suitable for specific situation.

There are four sets of indicators A, B, C & D (Fig. 19), and each set consists of four indicators covering the range of visible sky shapes. The indicator related to a wide but shallow patch of sky as shown in Fig. 18A is numbered 1, and that for a narrow but deep one (Fig. 18B) is numbered 4; the intermediate ones are 2 and 3.

The C and D sets of indicators are used for testing the face of one building on a plan to ensure that it is not obstructed by other buildings. The C set has been devised for non-residential buildings. This in view of the fact that deeper daylight penetration is desirable in offices so as to allow direct daylight to reach office

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[56] Ibid., p. 6.

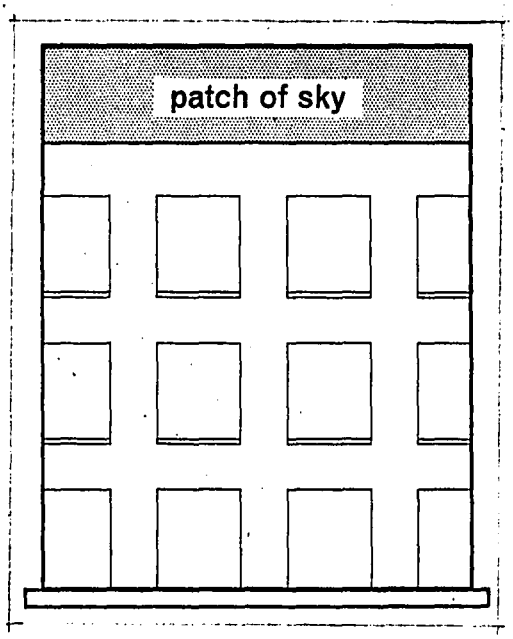


Fig. 18 A

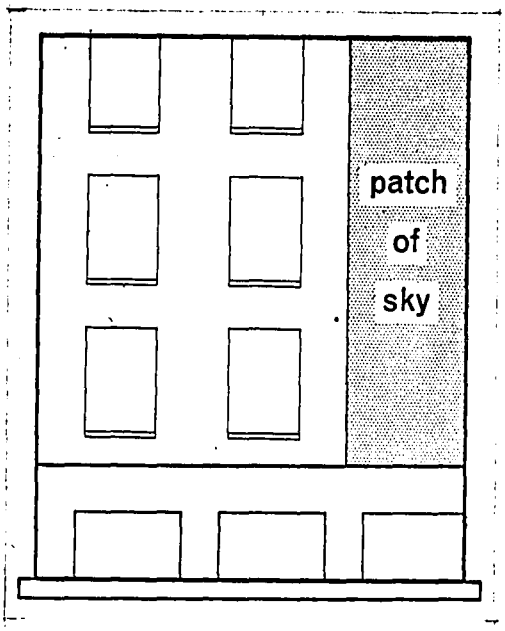


Fig. 18 B

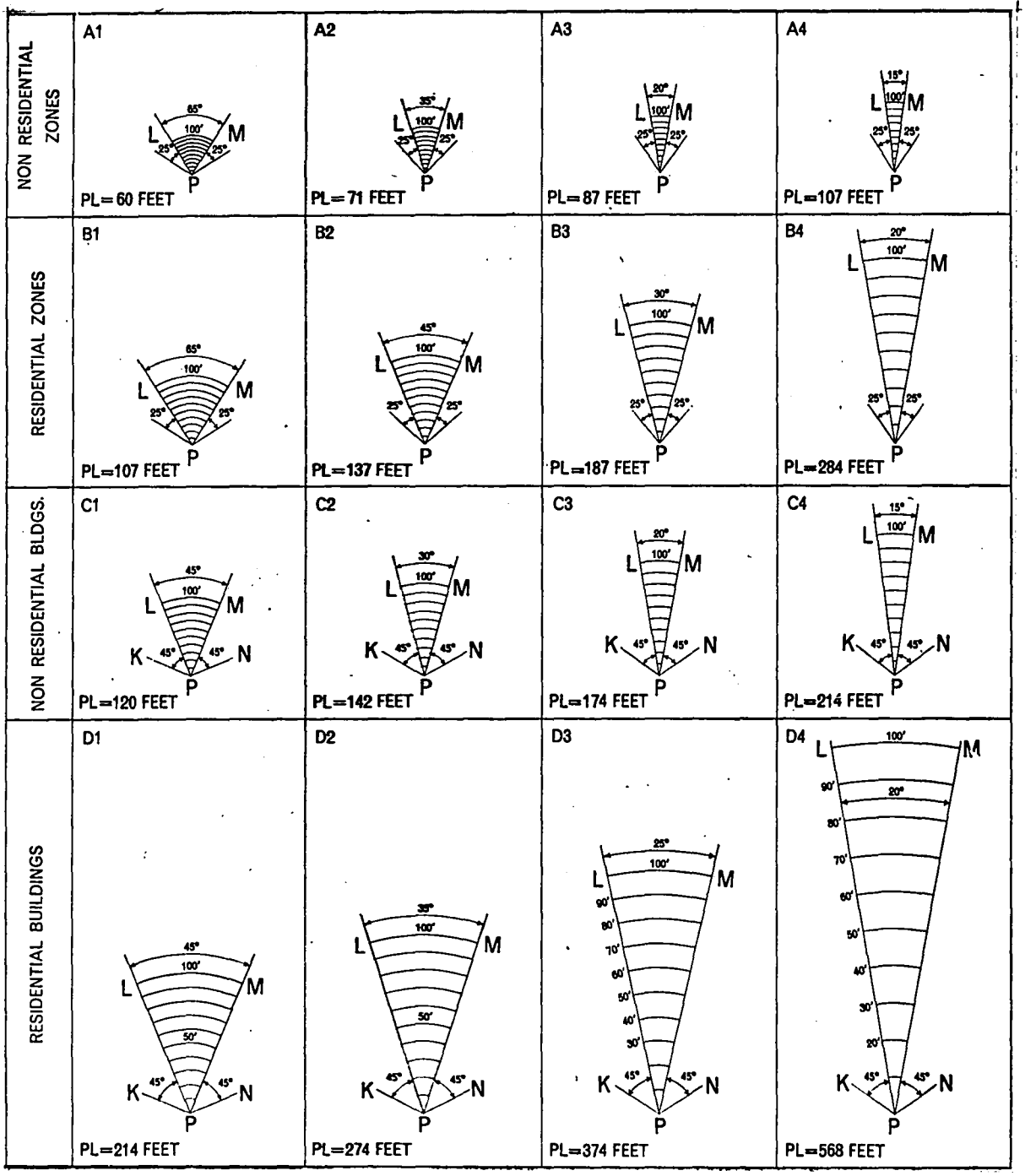


Fig. 19 FOUR SETS OF INDICATORS

A & B Series - For use from street centre lines and plot boundaries.
C & D Series - For use from other buildings on plot.

desks some distance back from windows. (Figs. 20 and 21)

For situations where the adjoining plots are vacant and the eventual form of the building there is unknown, two other sets of indicators (A and B sets) were developed in order to safeguard their adjoining lots, and on applying at the plot boundaries or street centre lines, to give permissible heights of buildings within it.

The 'A' set corresponds to the 'C' set for non-residential buildings and 'B' set to 'D' set for residential buildings.

While devising the above, the angle of acceptance was assumed as 90 degrees on plan and 45 degrees on either side of a line drawn at right angles to the face of the building, in order to ensure fairly deep penetration of daylight into the rooms to be useful.

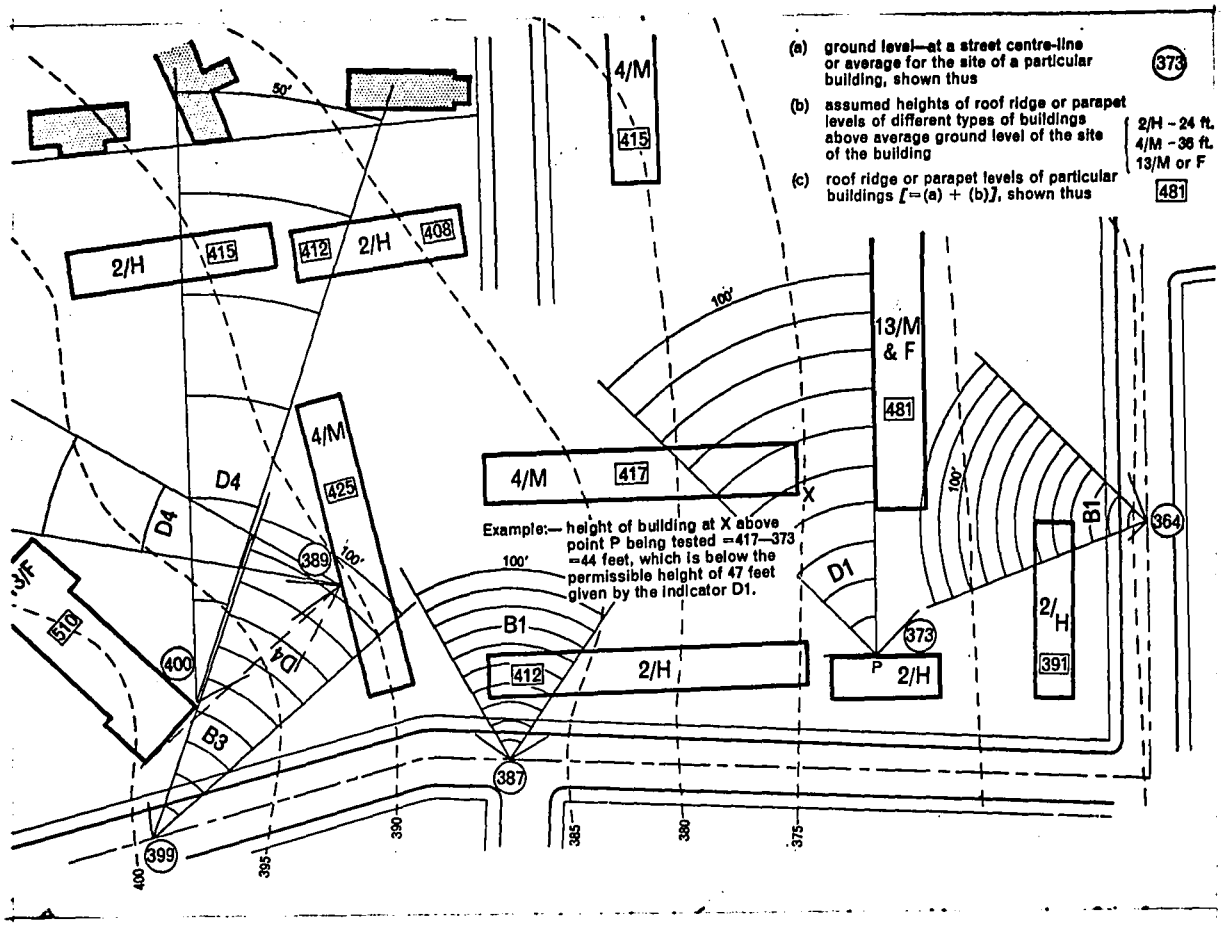
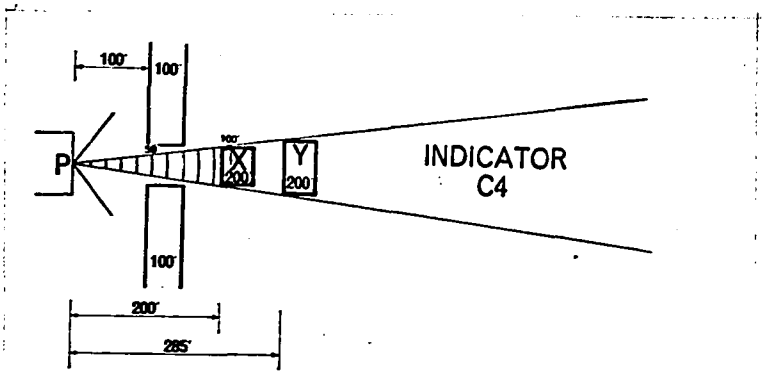


Fig. 20 This layout complies with the daylighting standards. For clarity the diagram shows indicators in selected positions only. Nevertheless all points on the centre lines of surrounding streets and on the plot boundary lines must pass the test with one or other of the four type B indicators, and all lengths of building face where there will be windows must pass the test with one or other of the four type D indicators. Compliance in either case may be attained if light reaches the point being tested either over a building (for which the narrow-angle indicators are the most useful).



Daylight at point P on a non-residential building would be completely obscured by a 200 feet high block at X (53 feet wide) and 50% obscured by a 200 feet high block at Y (75 feet wide).

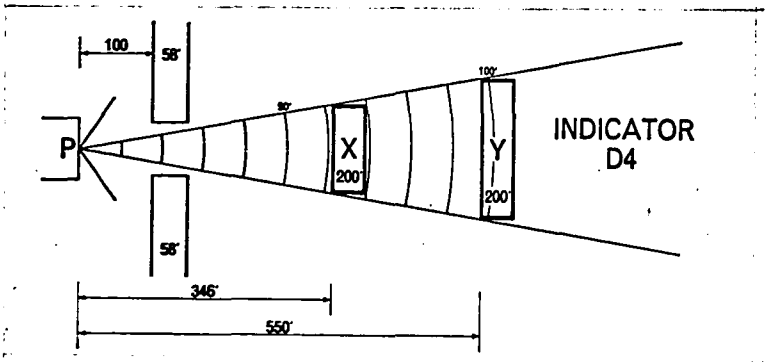


Fig. 21 Daylight at point P on a residential building would be completely obscured by a 200 feet high block at X (122 feet wide) and 50% obscured by a 200 feet high block at Y (194 feet wide).

SUNLIGHTING:

The need for sunlighting especially in dwellings in urban areas has been getting increasing importance recently, as it is considered a necessity for biological needs of human beings. There are three main considerations in the human need for sunlight: visual, thermal and psychological. The relative importance of these factors was a subject of discussion in some of the conferences of the Commission Internationale de l'Eclairage at New Castle, England,[57] in 1965. From the illumination point of view, the concern was with the problems of illumination with direct or reflected sunlight, from thermal point of view the exclusion of direct sun rays. It was, therefore, concluded that the critical criteria for standard of admission of sunlight to buildings must depend upon psychological consideration. It was also agreed that the main body of research in this field still remained to be done, and architects and public health officials still had to depend on their experience and intuition.

In a study included in the regional plan of "New York and Its Environs"[58] particular emphasis was laid on the beneficial effects of sunlight from the poiht of view of health. It suggested,

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[57] Sunlight: Report of Cie Conference: The Architects' Journal: Information Library; May 12, 1965; p. 1129-32.

[58] Committee on the Height, Size & Arrangement of Buildings, Report of the Height of Buildings Commission: City of New York; December 23, 1913; cited by Harold MacLean Lewis, Planning the Modern City, Vol. I, p.

as a reasonable minimum standard, that every living or sleeping room should have such "an amount of sunlight or its equivalent" as would be supplied by the sun shining for one and a half hours at its maximum or noon intensity through windows of the prevailing dwelling house size, facing south on the shortest day of the year. It was found that the standard could be met in all rooms facing on streets which do not deviate more than 10^{o} from north and south in the latitude of New York (45^{o} 45').

In Britain in 1944 a committee on the lighting of buildings recommended about the orientation and limitation of obstruction to dwellings, and schools which would enable these buildings to receive a certain amount of winter sunshine.[59] It ensured that one of the windows forming the main source of sunlight should be so placed that sunlight can enter for at least one hour of the day, during not less than ten months of the year.

In arriving at thisstandard,

(a) Sunlight is not considered as entering a room if the horizontal angle between the sun's rays and the plane of the window is less than $22\frac{1}{2}$ degrees, and,

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[59] Ministry of Housing and Local Government, Planning for Daylight and Sunlight: p. 14.

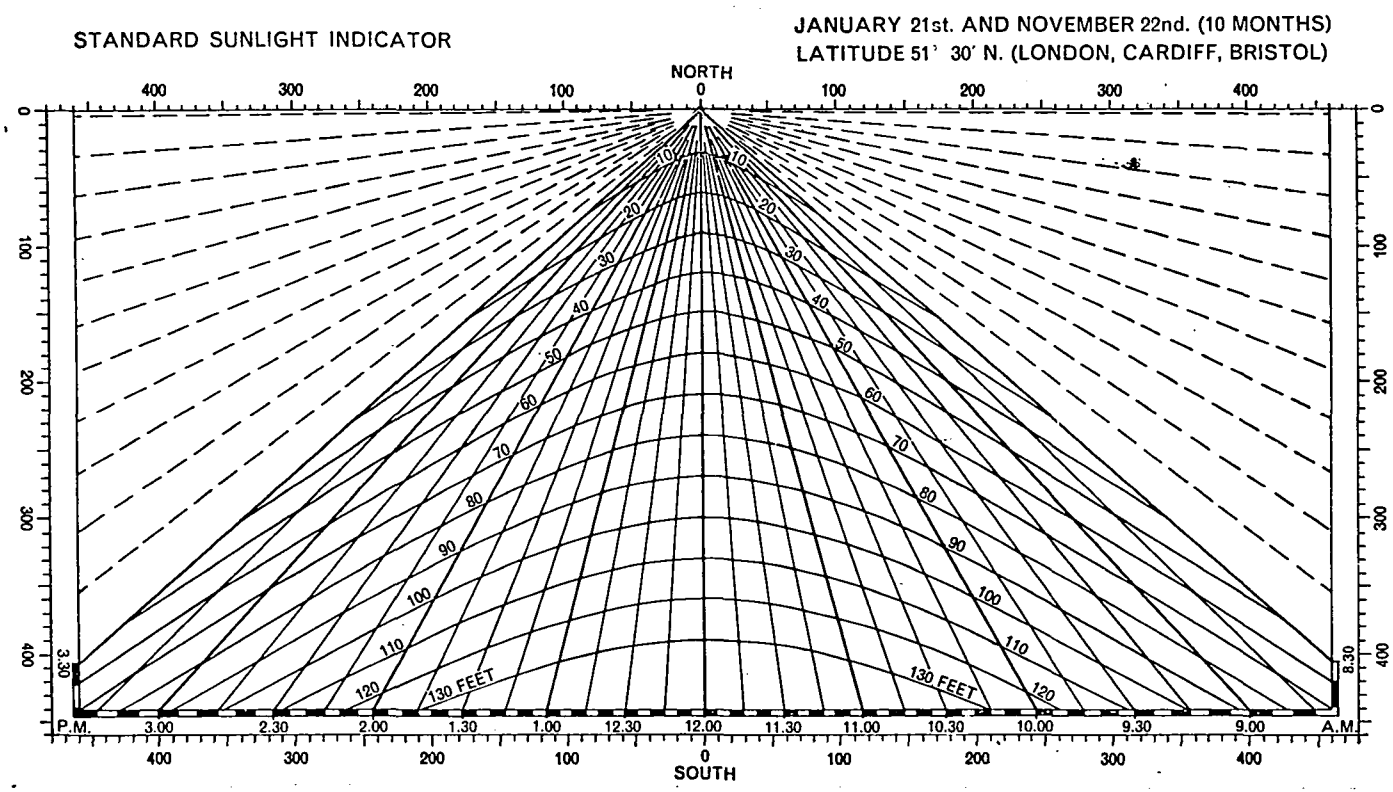

Fig. 22 Standard Sunlight Indicator, for 51° 30' N., the approximate latitude of London, Cardiff and Bristol.

(b) Sunlight is not considered to be useful unless the sun has an altitude above the horizon of more than 5 degrees.

A sunlight indicator was developed which primarily dealt with sunlight in relation to residential buildings alone, although it could also be employed for the structures also, where receiving sunlight was considered essential. (Fig. 22) When placed on a layout plan against the window of a building, the indicator is designed to show how long that window could be lit by the sun on January 21st and November 22nd. (Fig. 23.)

Each curved line traces the minimum distance from the window at which an obstruction of the height shown against the line would just allow the light of the sun to reach the window at the corresponding times of the day on both January 21st and November 22nd. The height of the permissible obstruction is the height above the sill of the window being tested, and not the height of the obstruction above ground level. Since the indicator is to scale, the distance from the window can be measured off along the radical lines.

Use of Indicator for Predicting Shadow Movement:[60]

If the standard indicator is turned 180 degrees from

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[60] Ibid., p. 18.

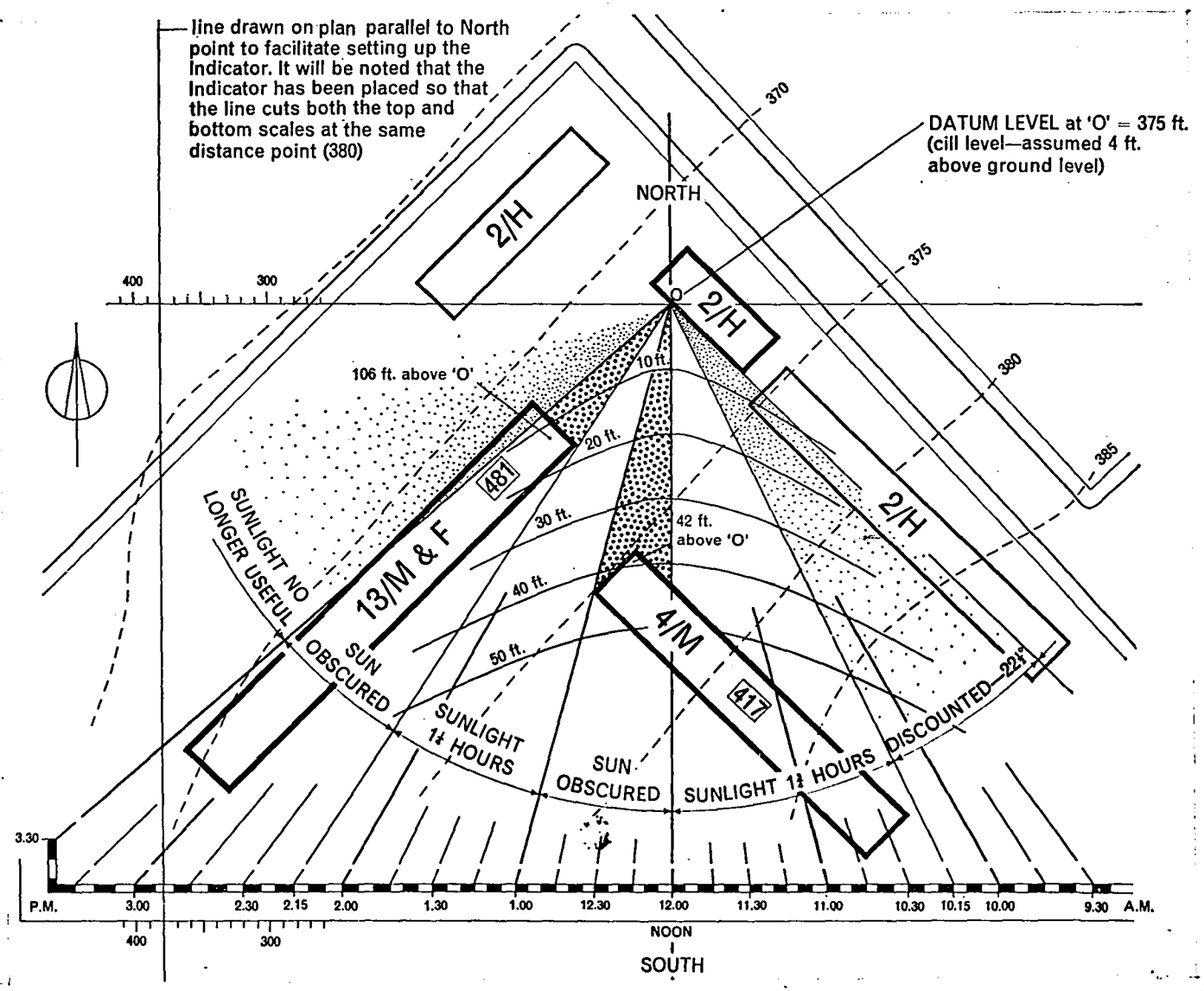
line drawn on plan parallel to North point to facilitate setting up the Indicator. It will be noted that the Indicator has been placed so that the line cuts both the top and bottom scales at the same distance point (380)
DATUM LEVEL at 'O' = 375 ft. (cill level—assumed 4 ft. above ground level)
NORTH
2/H
2/H
2/H
13/M & F
481
4/M
417
O
370
375
380
385
400
300
106 ft. above 'O'
10 ft.
20 ft.
30 ft.
40 ft.
50 ft.
42 ft. above 'O'
SUNLIGHT NO LONGER USEFUL
SUN OBSCURED
SUNLIGHT 1½ HOURS
SUN OBSCURED
SUNLIGHT 1½ HOURS
DISCOUNTED—22½°
3.30
P.M.
3.00
2.30
2.15
2.00
1.30
1.00
12.30
12.00
11.30
11.00
10.30
10.15
10.00
9.30
A.M.
NOON
SOUTH

Fig. 23

its north/south orientation, it can be used to show the movement of the shadow cast throughout the day by a building (Fig. 24).

The orientation and spacing of buildings in accordance with the standard sunlight indicator ensures that there is no unreasonable overshadowing of the main windows of one building by another.

In the United States the necessity for sunlight in dwellings has been contained in the recommendations by The American Public Health Association, in their report issued in 1948 on "Planning the Neighbourhood":

> "The need for sunlight, light pleasant rooms and open spaces for recreation is a fact on which everyone agrees, but the formulation of exact standards has been hampered by lack of means of measuring the precise amount necessary. The American Public Health Association recommends as a goal for daylighting of all new housing, that at least half of the habitable rooms of every dwelling unit receive direct sunlight for one hour or more during mid-day (between 10 a.m. and 2 p.m.) at the winter solstice. As sun is then at the lowest height the penetration specified shall ensure sunlight in all seasons".[61]

The spacing of buildings thus depends on the degree of latitude where the city is located. In New York it has been calculated that for the lowest window in a building to receive any sunlight at all

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[61] "Building Size, Shape and Placement Regulations", Yale Law Journal, p. 511. (extracts from foot-note no. 21)

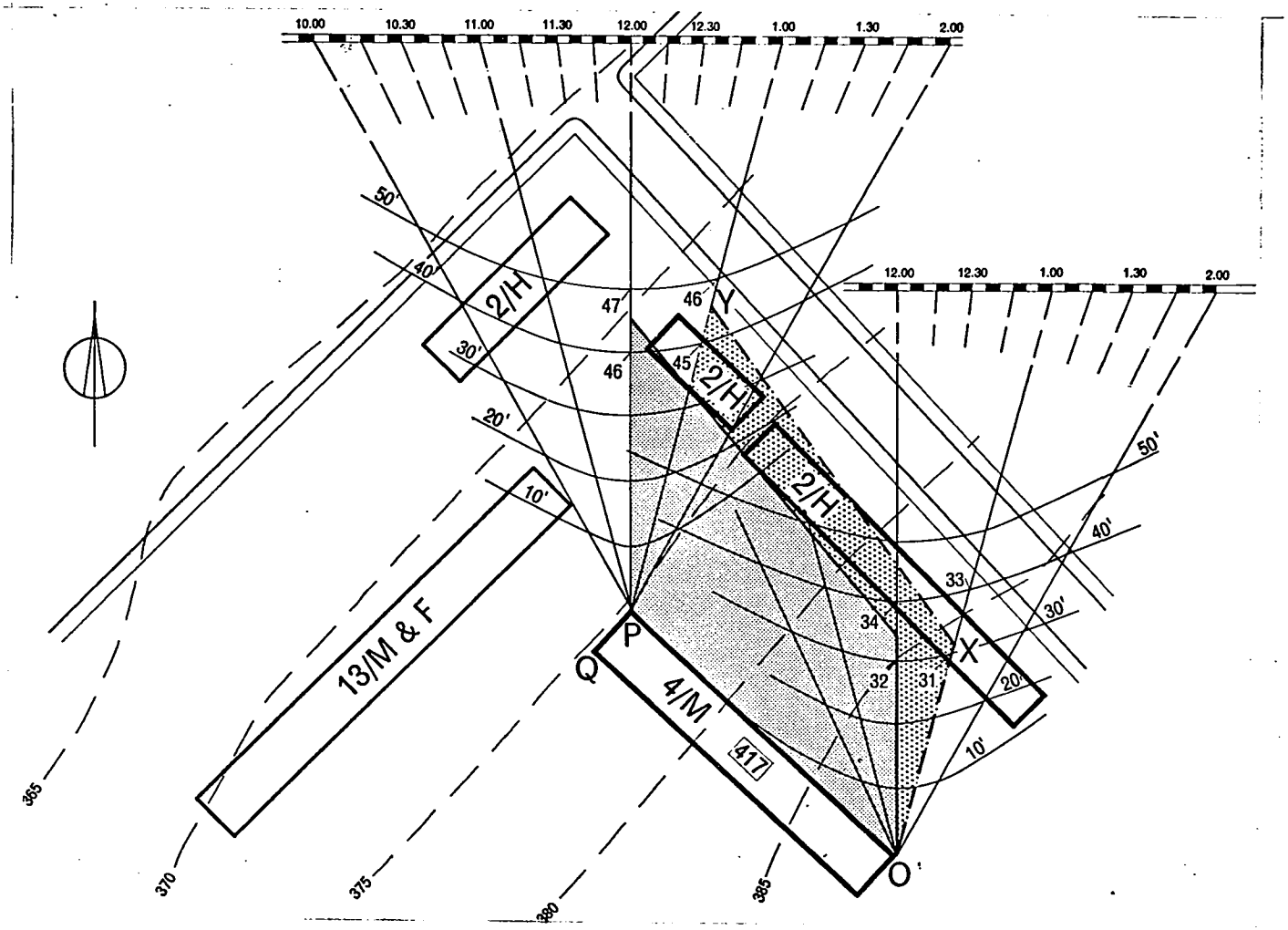

Fig. 24 The roof ridge or parapet level of the building at O, less the ground level at any point, gives the height (h) of the building above that point.

during the winter months, the distance to the next building south must be at least twice the height of the building. (The height of the sun at noon on December 21st in New York is $26\frac{1}{2}$ degrees, thus buildings cast a shadow twice their height.[62])

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[62] Ibid., p. 511.

THE URBAN MICROCLIMATE

Even though the microclimatic knowledge is widely available, most of the cities evolve their zoning regulations without considering the climatic factors involved. The empirical data available on the subject as well as the research done point out the desirability of considering this factor to improve the urban environment. Apart from various elements which constitute the microclimate of an area, only the temperature and flow of wind are relevant to this study.

1. Control of Temperature:

It is well known that every building changes the climate in its vicinity, however small, until through the process of urbanization, drastic climatic changes may result. The buildings increase the heat-absorbing surfaces, over and above the heat generated by traffic, exhausts, smoke-stacks, etc. and consequently the temperature of the urban areas is warmer than the adjoining countryside.[63]

The general relationship between the height of a structure and the distance of the next structure effects local temperature as indicated in diagram No. 25.

A compact series of buildings with narrow open spaces interspersed with wider open spaces is a good arrangement for a

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[63] Lawrence Halprin, New York New York.

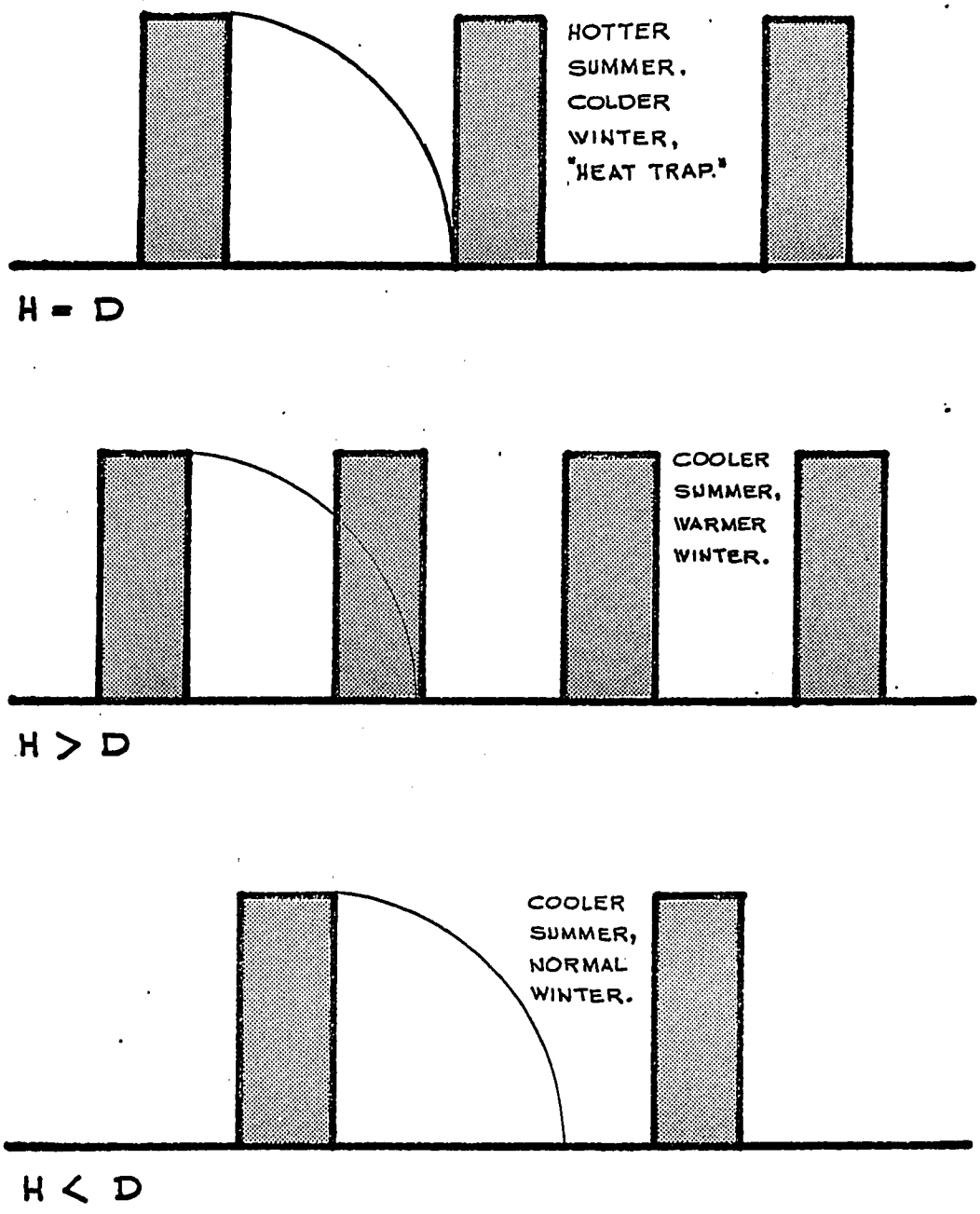

FIG. 25. EFFECTS ON MICROCLIMATE.

high density area for the creation of a more comfortable micro-climate. However, the actual size and arrangement of open spaces as well as their landscape patterns should vary with individual site for desirable results.

2. Wind Flow:

It is observed that wind speed in urban areas is slower and more turbulent, especially at lower levels because of irregularity of terrain as compared to the open countryside.

H. C. Shellard in his studies on climatology writes:

> "Isolated tall buildings are liable to create down draughts in their vicinity and sometimes a local increase in speed, and the effects of such buildings may extend downwind to twenty or more times their height. In some cases the air movement may not be sufficient to remove pollution adequately; e.g. from motor vehicles, etc. This is more likely to be serious in areas where the buildings of the same height are closely packed together."*

It is interesting to note the behaviour of wind against wind-breaks, wind-screens, shelter walls, etc. When used with isolation studies, it is possible to take full advantage of local climate factors in orientation and even in planning a structure as

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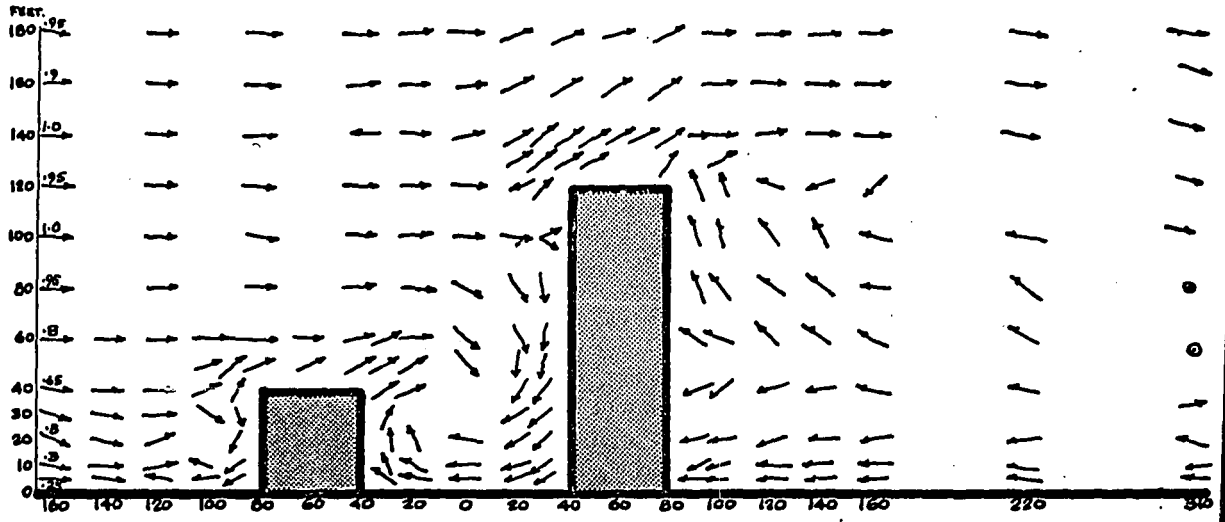
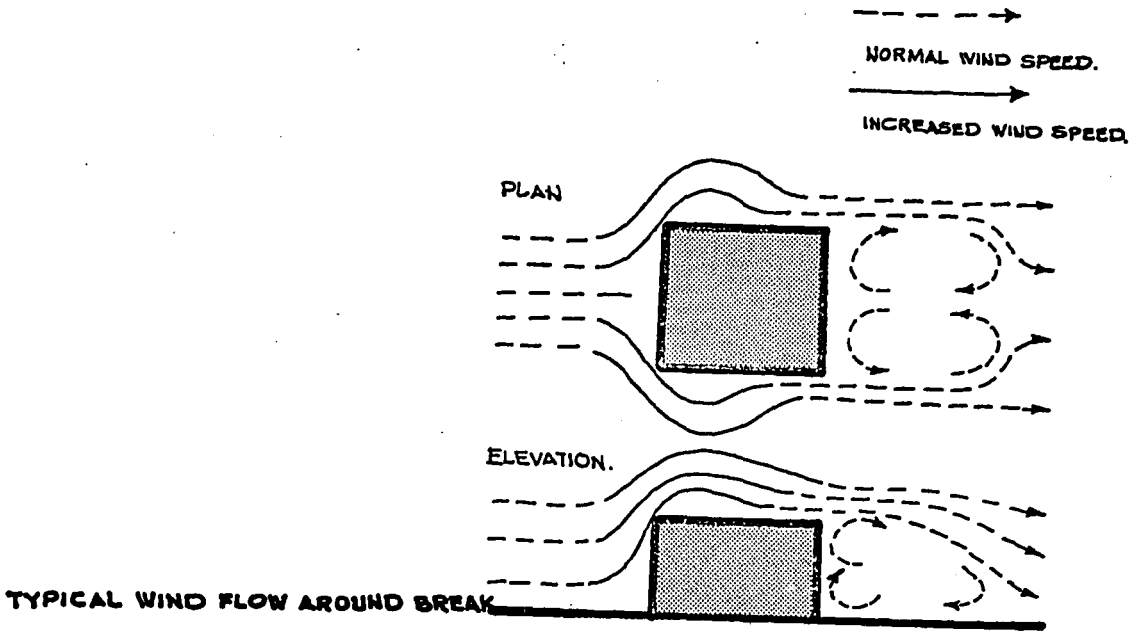
* Architects' Journal, Jan. 13, 1965. p. 84.



EFFECTS OF WIND ON TALL SLAB FRONTED BY A LOW BLOCK.



TYPICAL WIND FLOW AROUND BREAK

FIG. 26. TYPICAL WIND FLOW DIAGRAMS.

well as laying the associated open spaces to minimize climatic unsuitability. At the ends of a wall or corners of a structure, wind speed will increase by as much as 20%. At openings within the construction, this speed will increase even more and create the so-called "Funnel Effect". (Fig. 26)

FIRE-FIGHTING:

The estimation of how long a fire will burn in a compartment as well as its relative effect on the shape and volume of the buildings is important in devising rational building codes. However, the regulations enacted in this connection are so far arbitrary and need extensive research.

Mr. P. H. Thomas and A. J. M. Heselden write in one of their research projects regarding behaviour of fully developed fire in an enclosure:**

> "It is generally agreed that a fire in a room with a small window loses weight at a rate largely controlled by the air supply. Increasing the surface area of the fuel, usually the wood, that is available, has been thought to have little effect on the rate of burning, though it is known to be the main factor (and the window size almost irrevelant) when the window is large in relation to the surface area (i.e. the floor area) of the compartment.
>
> "Recent experiments with fires in model room with a small window have shown a systematic but weak increase of burning rate with increased fuel surface area".

There is, however, no evidence of any research done regarding the external shape of the structure except the heights of buildings, such as the 80 foot maximum vertical height once permitted in London.

** Combustion and Flame: September 1962.

Advances in technology for fire-fighting has evidently eliminated the necessity of any such restrictions today. The spatial relationships of structures, with a view to fire-fighting from street level, as well as spread of fire from one building to another are, however, some of the important factors which are relevant to the design of open spaces around structures. In this connection Prof. Howard Emmons of Harvard University, who was contacted for advice in this field, has some useful remarks in his letter dated January 17, 1969 (Appendix I).

OPEN SPACES:

Open space in the context of this study implies urban space around structures to satisfy the physical and psychological needs of man. These spaces play a dominant role in urban environment and are as important as the structures themselves.

In spatial sense open space has many attributes. It may range from open space of the street, space around buildings in the form of plazas, or space of a park system. These spaces are either meant for rest and recreation or to form link between different elements in the urban scene. In an article on "Major Spaces" the editors of Progressive Architecture write:

> "Set within the landscape of the city scape, these major spaces have invariably served as important visual punctuations. Master builders throughout history have been fascinated by their placement, their size, their shape, their structure, the choice of material color and have found innum erable and ingenious ways of utilizing these major spaces in the urban context."[66]

Many theories have been put forth regarding the size of open space, but they all have a subjective undertone. The concept of space has also had a different meaning at different times in history. The spaces in the form of public squares in old city centres were designed for large civic gatherings, which was a

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66 "Major Spaces - Exterior Volume", Progressive Architecture, June 1965, p. 166.

need of the time, but the present day urban areas dictate other requirements.

The provision of daylight, sunlight, fire-fighting, privacy, fresh air, urban microclimate and noise control, etc., are some of the considerations which play an important role. The form of structures also exerts its own influence on the space volume. (Fig.27) Most of these requirements are covered under the controls over maximum coverage, angles of light, set backs and minimum yard dimensions, etc. Such spaces are, however, fragmentary in nature and, therefore, more recently New York City regulations have laid down the provision open space ratio (O. S. R.). It relates open space with the number of families in a residential development. In commercial buildings the plaza bonus system adopted in some of the cities ensures some open space at ground level which provides a welcome relief under conditions of overcrowding and congestion.

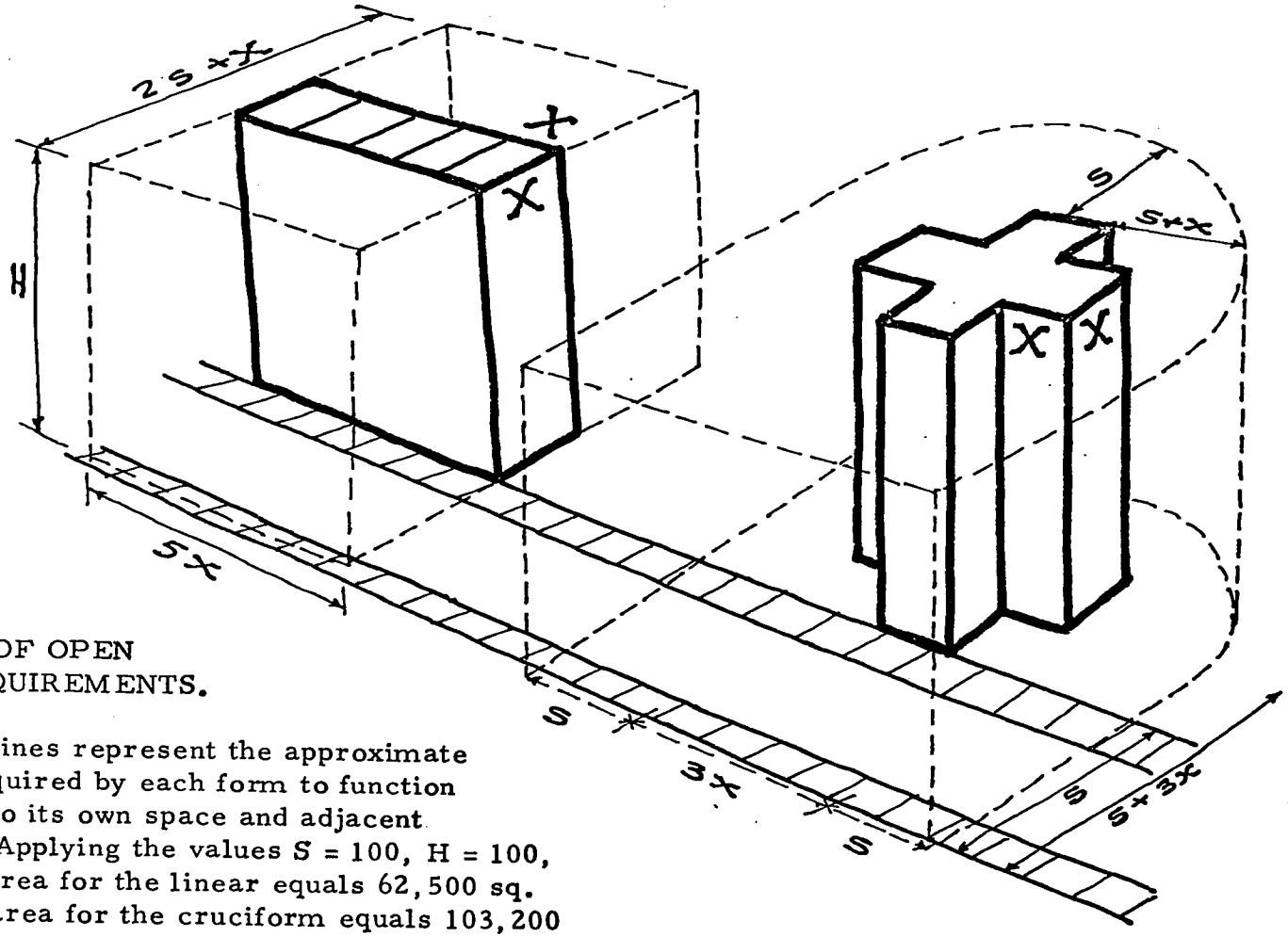

Fig. 27.

ANALYSIS OF OPEN SPACE REQUIREMENTS.

The dotted lines represent the approximate volumes required by each form to function in relation to its own space and adjacent buildings. Applying the values S = 100, H = 100, X = 5, the area for the linear equals 62,500 sq. ft. and the area for the cruciform equals 103,200 sq. ft.

PART II

Chapter IV MONTREAL - SPECIAL AREA STUDY

THE AREA:

The area at the southern slopes of Mount Royal has been chosen for study in view of its proximity to the downtown core of Montreal, and consequent tendencies of intense growth and development. Zoning bylaws affecting the area have also been the subject of controversy lately between developers and the City Authorities, giving added significance for its detailed observation.

The limitations of its boundaries are determined by the character and function of the adjoining areas which help to give it an individual identity.

To the North:	The Mount Royal Park together with the cemeteries form the reserve of greenery.
To the South:	The city centre with its present limits up to the south side of Sherbrooke Street.
To the West:	The Grand Seminary of Montreal and the Montreal General Hospital.
To the East:	McGill University.

Thus surrounded, the area forms a polygon limited by Pine Avenue, McTavish Street, Sherbrooke Street and Cote des Neiges Road. (Fig. 28)

The territory has both historical and cultural significance and has always been regarded as a prestigious residential locality. Its growth has been subjected to a variety of influences due to its proximity to the Mountain, McGill University and the city centre, resulting in the creation of an area of exclusive residential development interspersed with prominent institutional buildings.

The various zoning bylaws enacted to control its density and especially the volume of buildings have an aesthetic bearing, and tend to establish some visual relationship between the Mountain and the bulk of downtown development as seen from certain strategic points on the south shore.

This study is an attempt to analyze various forces which have brought about such regulations and the powers vested in the local authorities to set general guidelines for the growth and development of the city.

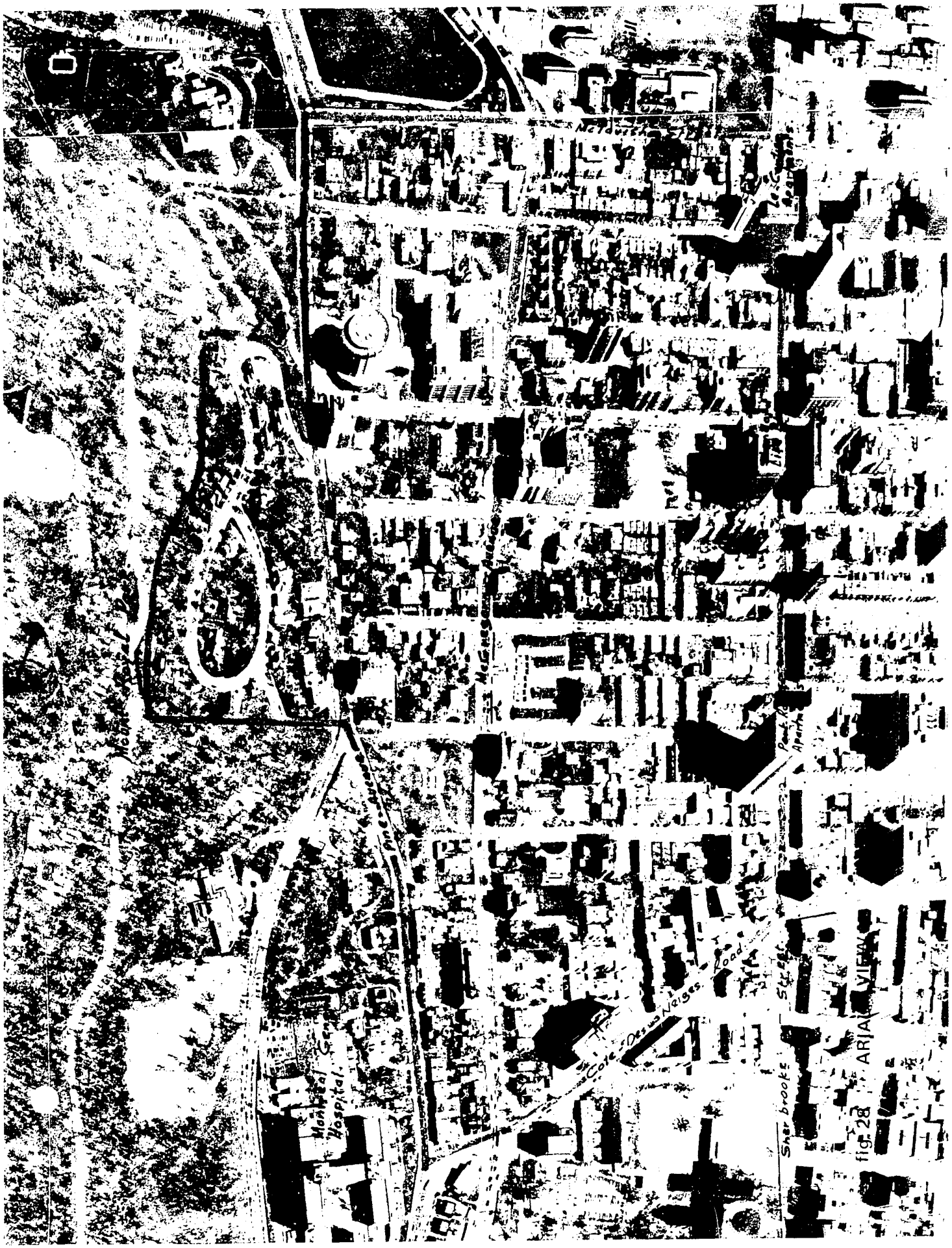

fig. 28 AERIAL VIEW

HISTORY OF DEVELOPMENT:

The development of the area under study is closely linked with the early settlement patterns on the Island of Montreal and the significance of Mount Royal to its inhabitants. The Mountain was a great attraction for the early settlers. It was one of the main reasons that in 1611 Champlain decided to make Montreal his headquarters for purposes of trade on the Continent. It offered a natural backdrop to a flat plateau on the edge of St. Lawrence River. Due to the importance of water travel in those days, the early settlements took place along the river, resulting in the familiar long lot system with narrow sides fronting the river. The settlement grew in size with the increase in trade and commerce, but the mountain remained a place of scenic beauty till the occupation of the Island by British troops in 1760. This area held a natural attraction for the new class of merchant princes, who were entranced by the sheer beauty and which offered a breath-taking view of the city as well as the river. Its significance is described in "Leacock's Montreal" in very lucid terms:

> "It was an area of unsurpassed beauty, undisturbed from the very nature of its situation by the noise of traffic or by the passage of the passerby. This is the district that we recall as lying just at the foot of the Mountain, unoccupied

> under the French regime and comprising in early British days, the beautiful forms and the stone manor houses of the McGills, the McTavishes, and such that reached all the way from what is now Fletcher's Field to the Cote des Neiges Road, covering all the river face of the mountain slope. For the area McGill University presently formed one boundary. The rest was laid out into spacious side streets running up to the hill from Sherbrooke Street till they could run no further. Each street was then blind with that happy blindness that spells peace. The elms that grow so easily on Montreal Island, thus left in secluded growth, fashion each street to a Goethic Cathedral. Here in generous grounds arose the mansions of the rich..."[67]

The Mountain not only provided a panoromic view of the river and place of quiet retreat, but had an important place in the image of the city. Dorwin, a traveller from Europe in 1816, describes:

> "Passengers headed for the Island could at least comfort themselves with the view of the city which at a distance 'was quite imposing'. The large number of buildings, then roofs covered in tin, glittering in the sun, was something very new to me. It had a showy appearance, and in summer the circumjacent scenery is exceedingly beautiful. Behind and to the left of the city rises the mountain, from which it originally took the name....Placed like a rampart behind the city to shield it in winter from the unkindly blast..."[68]

The advances in technology brought greater mobility and by the end of the 19th century the commercial functions began to establish outside the fortifications surrounding Montreal, resulting

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[67] John Cullition, Leacock's Montreal, p. 233.

[68] Kathleen Jenkins, Montreal - The City of the St. Lawrence, p.253.

in the development of St. Catherine Street plateau, and relocation of the residential zone which began to occupy the Sherbrooke Street plateau and the south side of the mountain.

The decision to establish the top of the mountain as a public park in 1874 was a significant event which reaffirmed its importance in the life of Montrealers.

> "Most promising of all, however was the Corporation's acquisition of Mount Royal, for conversion into a public park. It proved to be a long and tedious process. For many years after the death of Simon McTavish, the upper slopes were used as grazing grounds for cattle, fenced in and barred from the citizens, but otherwise completely neglected. Public protests dated from the sixties, when a man named Lamothe purchased a part of the mountain and proceeded to cut down the timber and sell it for firewood. The more civic minded of the inhabitants deemed it imperative to save the summit from any such desecration. That their pressure was effective, is evident from the act passed by the Provincial Legislature in 1869, authorizing the corporation to borrow a sum not exceeding $350,000 for its purchase.....This went on until January 1875, it being necessary in the interval to secure permission from the province to increase the loan to $1,000,000. On the Queen's birthday of that same year Mayor Hingston officiated at the formal opening of the 485 acres thus far taken over, and twelve months later, he told of the completion of two miles of road graded easily for the convenience of the public."[69]

The importance of the park to the life of the people is further evidenced by the fact that the city sent a deputation to examine the principal parks in the United States and resulted in engagement of

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[69] Kathleen Jenkins, Montreal - The City of St. Lawrence, p.413.

an eminent landscape architect, Mr. Olmstead, of New York for its design.[70]

LAND SUB-DIVISION:

Since understanding of past patterns aid in our comprehension of the present, early land sub-divisions form an essential element in the analysis of an urban area. The initial patterns of sub-division on the Island of Montreal took the form of long lot system with narrow sides fronting on the river affording equal opportunity for everyone to have access to the river transport. The gradual urbanization of these farmlands resulted in gridiron pattern of streets in most part of Montreal except where large parcels of land were held in single ownership. The formation of typical street pattern in area under study is depicted in Fig. 29 showing three stages of development.

CADASTRAL DIVISION:

The original aims of the cadastral division in the Province of Quebec were to open up the land for settlement and secure a system of taxation. This was provided by the Cadaster Law,[71] introduced by Sir Georges E. Cartier in 1857.

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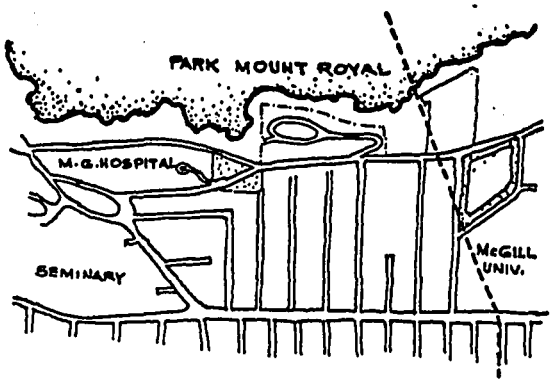
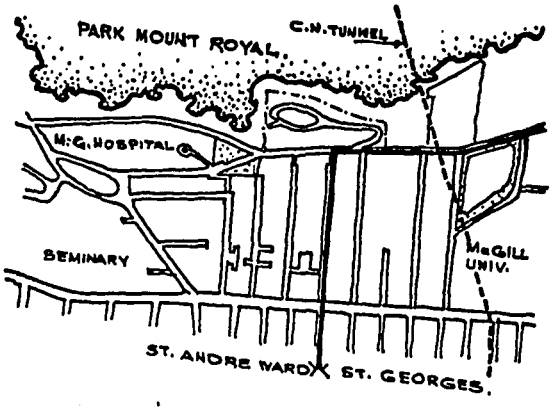
[70] Archives Municipales, Montrea; Rapport Annuel de l'Inspecteur de la Ville, Annee 1875, p. 3 and 4.

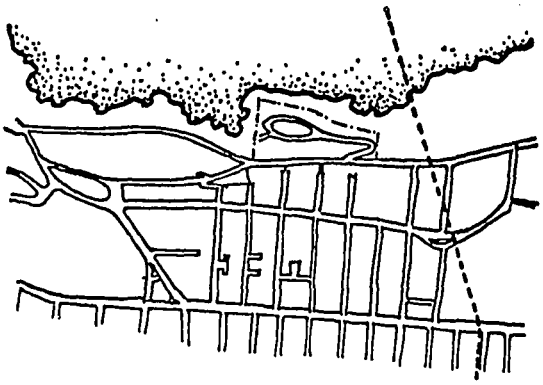
[71] Consolidation Statues of Lower Canada, Vict. 23, Cahpt. 59, 1857



1910.



1931.



1970.

STAGES OF DEVELOPMENT.

FIG. 29.

The division of the area under study dates back to September 1, 1870 when it was divided up in 80 lots numbering 1721 to 1800 covering an area bounded by Cote des Neiges, Sherbrooke Street, McTavish Street and north-west city boundary line.[72] (Fig. 30)

This resulted in large units of land to accommodate substantial houses and in course of time became a locality of pronounced significance, due to its geographical location and closeness to the city centre. The old pattern has persisted and the area has maintained its status through uncommonly large units of land. (Fig. 31)

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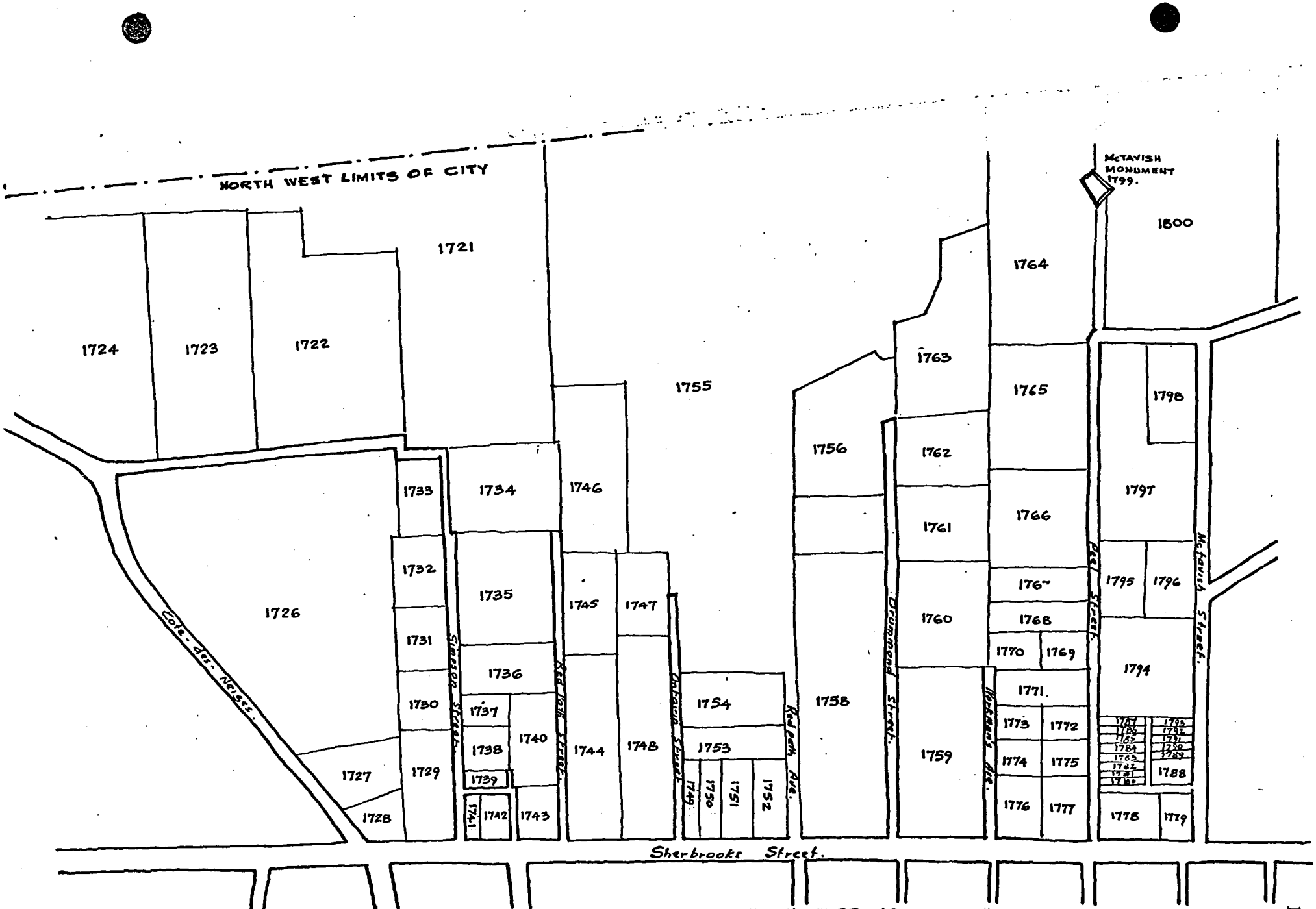
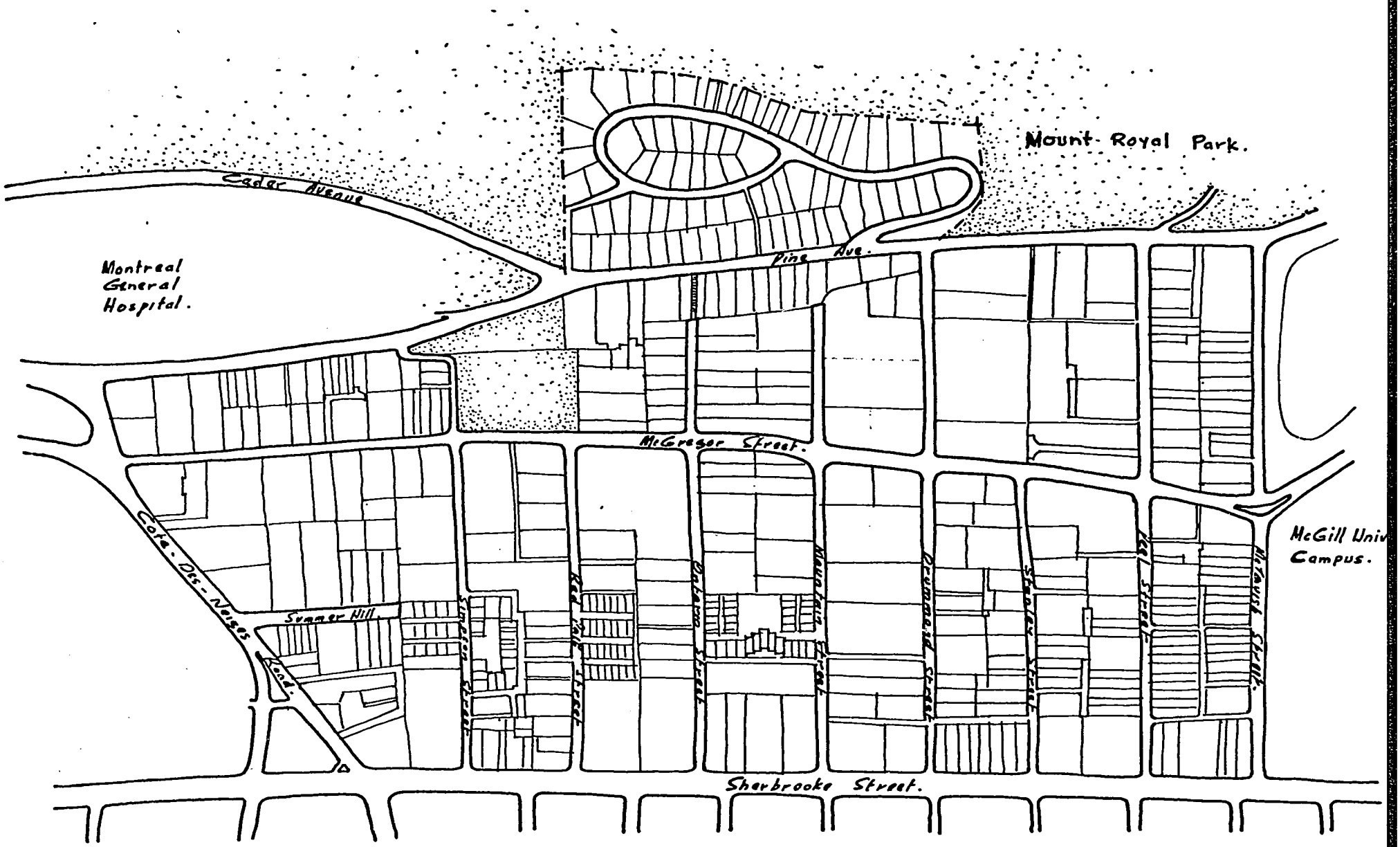
[72] See Appendix II for list of allottees and the areas of lots.



CADASTRAL PLAN: 1870.

PART OF ST. ANTOINE WARD: AS PUBLISHED BY T. H. LIONAIS, MONTREAL.

FIG. 30.



CADASTRAL PLAN: 1970.

FROM OFFICIAL RECORDS OF CITY OF MONTREAL.

FIG. 31.

ZONING REGULATIONS:

The presence of a mountain in the heart of Montreal has been a source of great inspiration and pride for its inhabitants. At almost every stage of its development efforts have been made to preserve the mountain from being devoured by the rapid urbanization process. Until 1940 this area was governed by general zoning regulations dealing with territories on both sides of Sherbrooke Street. This area had not come under sharp focus to require any special attention, as downtown area activities were still confined below Dorchester Street.

The study of bylaw No. 1132 enacted on July 24, 1931 concerning the erection of buildings on both sides of Sherbrooke Street within city limits, show that apart from other considerations of land use, etc., the City was more concerned with the minimum height of buildings than the maximum height, as the street still bore a suburban look and the authorities desired high buildings on this prestigious location. Article 4 of the above bylaw describes:

> "All buildings shall not be less than 38 feet high except apartment houses and commercial buildings which shall be not less than 5 storeys high."[73]

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[73] Bylaw No. 1132: City of Montreal, p. 4.

Bylaw No. 1651 adopted by the Council on November 12, 1940 seems to be the first conscious effort by the City to recognize the individualistic character of the area and set down maximum height limits and volume of buildings fronting on certain main streets. The rest of the territory was zoned for exclusive residential development in order to retain the existing suburban atmosphere which had come to characterize this area. Article I reads:

> "The territory bounded on the north by Mount Royal Park, on the east by the rear line of lots abutting on the east side of University Street, on the south by the rear line of lots abutting on the north side of Sherbrooke Street, and on the west by the rear line of the lots abutting on the west side of Cote des Neiges Road, between Sherbrooke Street and Cedar Avenue, is exclusively reserved for residential purposes."
>
> ".....in this territory no building shall contain more than one dwelling unit."

However, the lots fronting on major streets were permitted to have apartment houses with the following restrictions:[74]

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[74] Bylaw No. 1651: City of Montreal. p. 2, 5-6, 11 & 13.

Location	F.A.R.	Height	Coverage
1. Cote des Neiges Road		6 storeys (max. 10 on certain lots)	40%
2. McTavish Street Stanley Street		4 storeys	
3. Peel Street (res.)		4 storeys	
(prof. offices)	7.00	min. 30 ft. max. 100 ft.	60%
4. McGregor Street (between Cote des Neiges Road & Stanley Street) Pine Avenue. Cote des Neiges Road.	7.00	min. 30 ft. max. 100 ft.	60%

Apart from these restrictions, setbacks ranging from 10 feet to 25 feet were fixed on all roads.

No new controls were applied on buildings fronting on Sherbrooke Street which continued to be guided by the old bylaw, except that the depth for commercial development was restricted up to 150 feet on lots fronting on this road in one of the later amendments (Bylaw No. 2634 dated May 25, 1961).

The apartment building at 1545 McGregor Street West is an example of the structures built under this bylaw, which continued to be effective till the end of 1962 in this territory (Fig. 32).

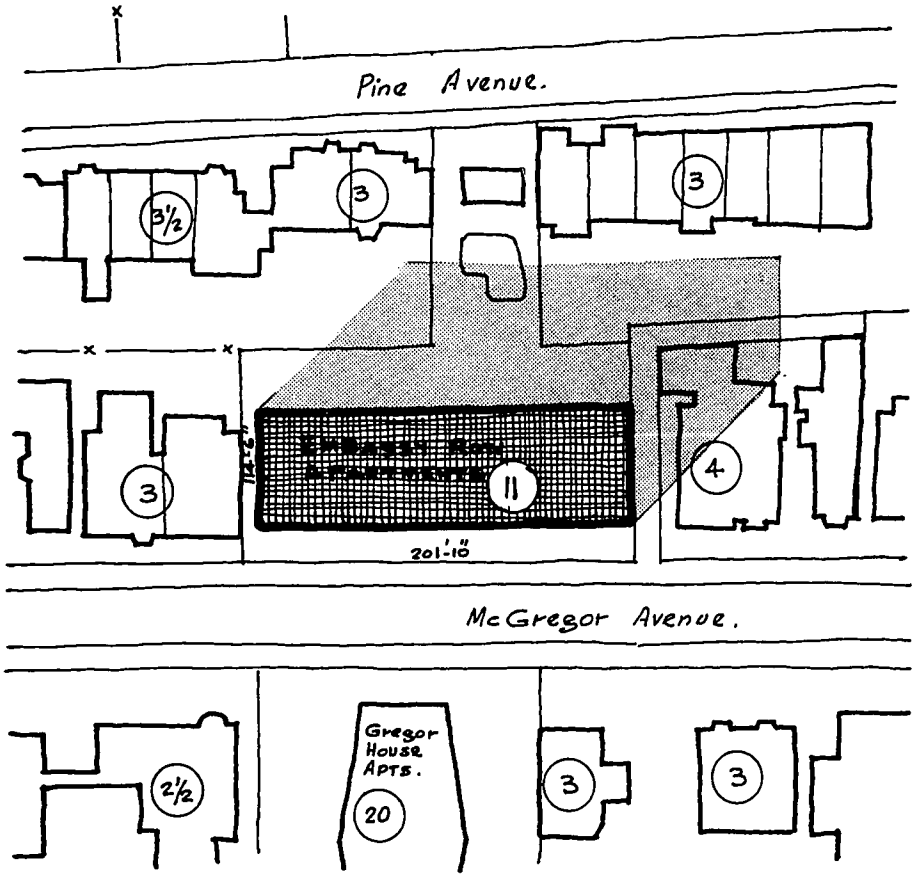

Fig. 32. EMBASSY ROW APARTMENTS. (Bylaw No.1651)
1545 McGregor Avenue

1)	Year of construction	1961
2)	Area of lot	28,977 sq. ft.
3)	Coverage on Main Floor	12,493 sq. ft.
4)	F. A. R.	7.00 (not fully utilized due to height & setback restrictio
5)	Number of floors	11
6)	Height	100'-0"

Meanwhile, a comprehensive Bylaw No. 1900 covering the whole territory of Montreal was enacted on November 4, 1948 and was a result of an urgent need to control the volume of buildings in a rapidly expanding metropolis. This bylaw applied to properties fronting on both sides of Sherbrooke Street, tended to control not only the maximum floor area with respect to lot area (F.A.R.) which was set as 12.00, but also laid restriction on the cubic footage of the building as 130 times the area of the lot, to effectively control the volume of buildings. The maximum height was set as 130 feet. The coverage for residential land use was 75% (maximum 90% for corner lots) and for commercial use as 100%.[75]

The circumstances developing around 1960 are quite interesting and had a profound influence on the future zoning regulations for this territory. This was brought about by a sudden boom of construction activity in Montreal at this time, especially in the downtown area and its reflection on the surrounding territories. Developers started to eye this territory with increasing interest.

An important event was the sale of the old site of the Montreal Childrens' Hospital on Cedar Avenue to a Swiss firm in May 1957 for residential development, who came up with a proposal of apartment towers in 1960. The maximum height permitted for buildings at the time was 100 feet (Bylaw No. 1651).

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[75] See Appendix III.

This had a series of protests from the general public who wanted to save the mountain from gradually disappearing behind the 'masonry walls'.

The remarks by Lt. Col. Lambert, Vice-President of Civic Action League in Richelieu Club Meeting on February 24, 1960 in which Park Department Director Claud Robillard and Director of City Planning Romeo Mondello were also present, represent the spirit of the time:

> "In order really to save the mountain which is to Montreal what the "Eiffel Tower" is to Paris, Col. Lambert called for zoning regulations which would limit the height of buildings in the downtown area..
>
> "If we do not control this, we will finish by building a wall around the mountain and it will be invisible."

The new zoning regulations he suggested would limit the height of buildings on Dorchester, St. Catherine, Sherbrooke, McGregor and Pine Avenue in such a fashion as to keep them rising like steps, but not so high as to block the mountain from view of the people in places like in south shore.

> "The mountain is symbolic of Montreal", he said.[76]

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[76] The Montreal Star, February 24, 1960.

At this stage a general awareness to have a realistic approach to zoning regulations and their desire to maintain the inherent beauty of their city is evident from an editorial in the Montreal Star which had the following comments on the existing state of affairs:

> "Earlier this year the Executive proposed and a rubber stamp council passed without debate, zoning bylaw changes affecting the area. One permitted the use of buildings for 'Non-Profit Social Clubs,' another pushed the commercial line on the north side of Sherbrooke Street back to 100 feet and a third pushed it still further back to 150 feet..."[77]

Conscious of its obligations towards the general welfare of the citizens, and their desire to keep the mountain from gradually disappearing, the earlier bylaw permitting the height of buildings up to 100 feet on Pine Avenue and McGregor Street was amended by City Council on November 6, 1961,[78] restricting the height of buildings skirting the mountain to 30 feet. This bylaw applied to buildings on Cedar, McGregor, Pine Avenue (from Cote des Neiges to Simpson), Redpath Crescent andSteyning Avenue. These regulations were not only resented by the inhabitants in view of the fear of a decline in property values, but were unrealistic to

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[77] Editorial, The Montreal Star, August 7, 1961.

[78] Bylaw No. 2694, City of Montreal, p. 2.

achieve their objective. The protest note from the residents of Pine-McGregor area reads:

> "It will result in chaotic construction as new construction at head of one avenue just outside the limits of 150 feet from Pine Avenue may be built up to 100 feet and will project approximately 32 feet over the projected height limit...
>
> "...The amendment is inconsiderate and premature and will result in deterioration of property within limits affected as the same was purchased in consideration of prospective building conditions under terms of existing building bylaws at the time of purchase."[79]

One of the buildings under construction at the time was at 1545 McGregor Street which had already been approved under the old bylaw.

North of Sherbrooke Street was another area of such activity where big developers came up with proposals to build high rise towers at certain locations. Permit for the Standard Life office buildings had already been issued on the basis of the old bylaws and two other apartment tower projects were under consideration by the City. These developments which had far-reaching consequences in shaping the later zoning regulations are discussed briefly.

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[79] The Montreal Star, November 7, 1961.

Standard Life Building:

Designed in 1960 according to Bylaw No. 1900 and other zoning bylaws controlling the structures on both sides of Sherbrooke Street (Fig. 33). As this was the first structure of its kind on this territory, there arose a strong public protest to the fact that something should be done immediately to save the mountain. The editorial comments in the Montreal Star read:

> "In recent years some buildings have been built on Sherbrooke Street effectively blocking out Mount Royal from public view. The Standard Life Assurance Company structure on Mountain Street is one such building. The Royal Embassy Hotel at Peel Street and its nearly completed addition which is higher than the original building is another.....
>
> ".....Two projects are under controversy with the City Authorities. One is the proposed hotel of circular design at the north-west corner of Sherbrooke and Peel, the other is $15,000,000 apartment project at the corner of Redpath and Sherbrooke."[80]

Port Royal Apartments:

The sketches for this project were submitted by the Redbrooke Estate Corporation in 1960 based on the old bylaws. The same were duly approved with slight modifications of increased setback distance from Sherbrooke Street. This resulted in a

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[80] Editorial, The Montreal Star, September 17, 1962.

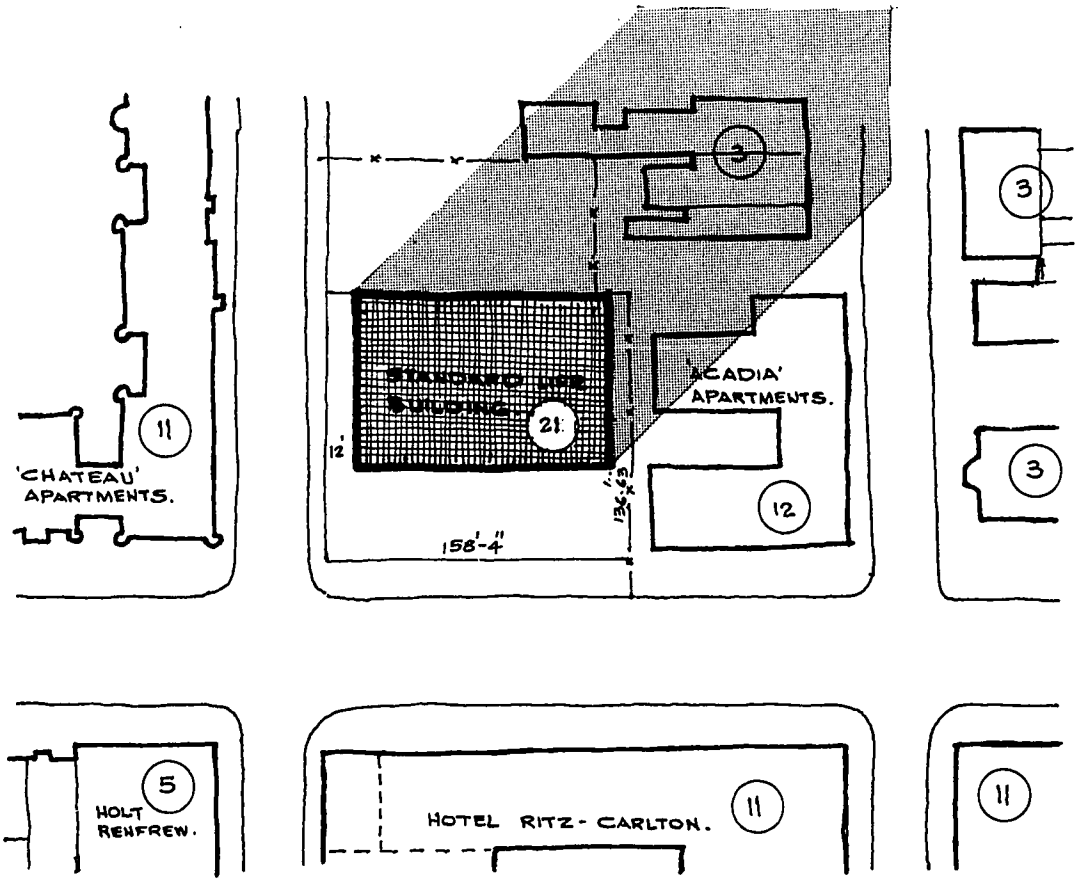

Fig. 33. STANDARD LIFE BUILDING. (Bylaw No. 1900)
1245 Sherbrooke Street West

1)	Year of contruction	1960
2)	Area of lot	21,706 sq. ft.
3)	Coverage on Main Floor	12,555 sq. ft.
4)	F. A. R.	12.0
5)	Height	281'-0"
6)	Number of floors	21

complete change in the building plans as the triangular shape of the previous plans no longer fitted the new dimensions. The detailed plans of the new scheme were submitted in applying for a building permit (Fig. 34).

The city planners had become aware of this new danger to the mountain and had since undertaken a detailed study of the area in order to deal with the challenge more thoroughly. The grant of building permits for the area were, therefore, suspended for a period of 90 days effective January 11, 1962, and further renewed for the same period on April 9, 1962.

As the issue of permit was being delayed by the City, the developers submitted a brief on May 15, 1962, outlining their fears of drop in property values, and pointing out the shortcomings of the proposals. This seemingly had no effect and the developers were left with no choice but to try for court intervention, which they did on August 10, 1962, to stop the enforcement of the new bylaw. A court injunction was served on the City Authorities to halt the City Council from giving final readings to the bylaw.[81]

A formal petition for a writ of mandamus was formally presented by Redbrooke Estate, to oblige the City to issue a building permit. An editorial commenting on this development read:

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[81] Montreal Star: August 16, 1962.

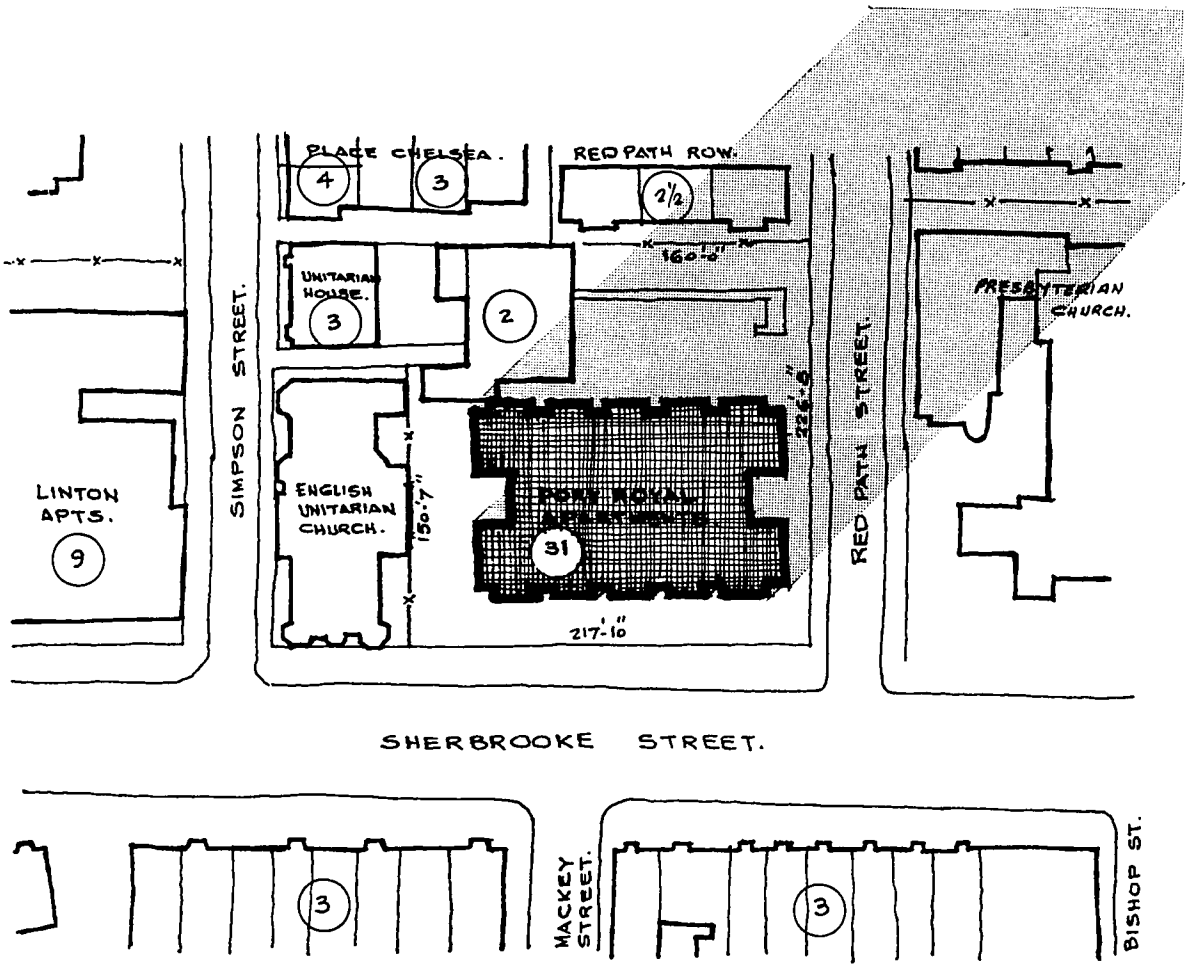

Fig. 34. PORT ROYAL APARTMENTS. (Bylaw No. 1900)
1455 Sherbrooke Street West

1)	Year of construction	1963
2)	Area of lot	44,542 sq. ft.
3)	Coverage on Main Floor	15,550 sq. ft.
4)	F. A. R.	12.0
5)	Number of floors	31
6)	Height	376'-3"

fig. 35. Area under study

> "Litigation on this complex affair started during the summer and a series of interim injunctions were issued at time, to prevent the City from putting into effect a draft bylaw, which would block the erection of building in question. As a result of these earlier proceedings, the City Executive Committee shelved for the time being its introduction of the bylaw to the City Council pending the court permission".[82]

The writ of mandamus was granted by Justice Maurice Archambault of Superior Court on November 23 ordering the City to grant a building permit. The City appealed against this decision, but finally had to permit the construction of the apartment tower.

Le Cartier Apartments:

The history of this project runs parallel to the Port Royal Apartments. Initially the developers - Peelbrooke Development Corporation - had plans to construct a circular hotel on this site. Due to the projected zoning bylaw, the issuance of a building permit was delayed. The developers joined hands with Redbrooke Estates Ltd. in fighting it out with the City. The plans were later changed for a 28-storey apartment project based on the existing bylaw, (Fig. 36) and the permit was issued by the City allowing its construction on January 22, 1963.[83]

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[82] The Montreal Star: November 19, 1962.

[83] The Montreal Star: January 23, 1963.

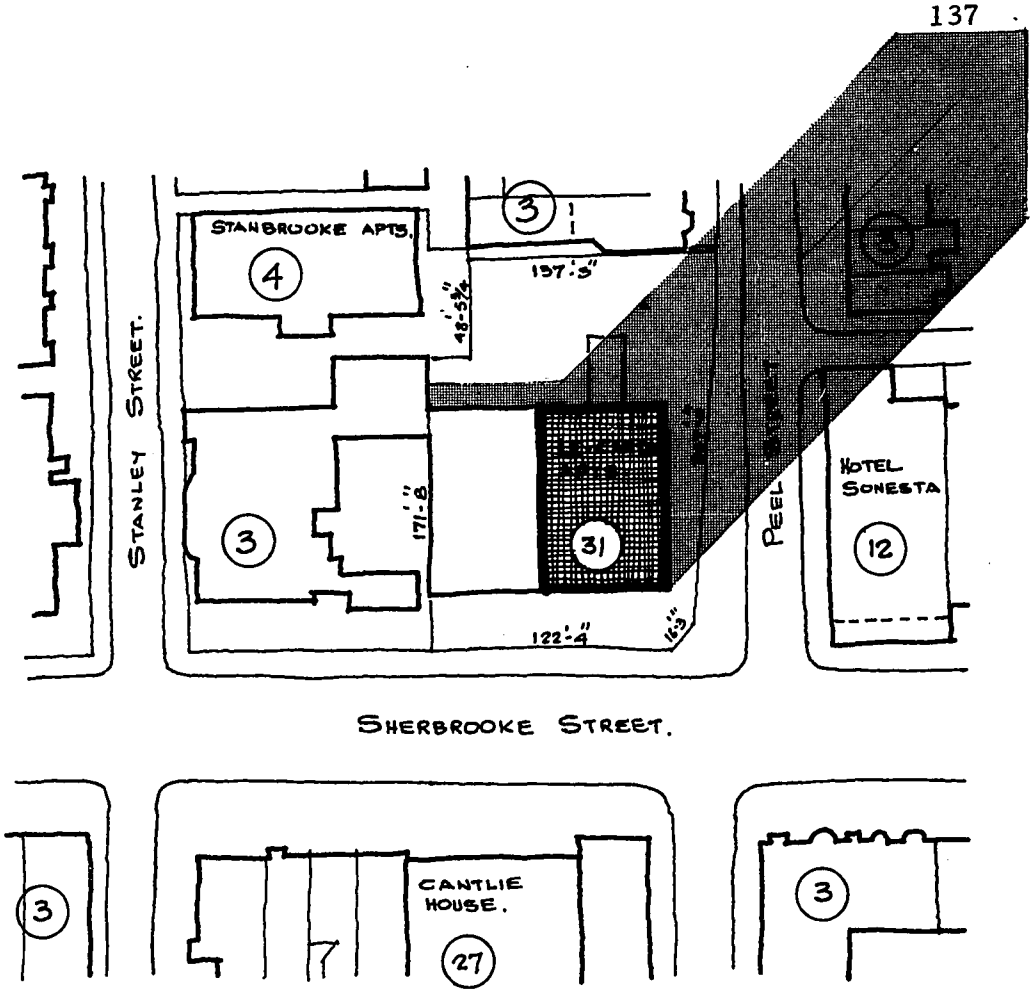

Fig. 36. LE CARTIER APARTMENTS. (Bylaw No. 1900)
1115 Sherbrooke Street West

1)	Year of construction	1963
2)	Area of lot	30,210 sq. ft.
3)	Coverage on typical floor	9636
4)	F. A. R.	12.0
5)	Number of floors	31
6)	Height	310'-0"

EVOLUTION OF BYLAW NO. 2812:

The detailed studies conducted by the City of Montreal were mostly aimed at establishing a relationship of the mountain with the downtown. The study by the Town Planning Department[84] published in March 1962, laid emphasis on the uniqueness of the mountain in the middle of the City and the desirability of preserving its configuration separate from the bulk of downtown development. This was particularly considered desirable while viewing the City from certain strategic locations on the south shore which were termed in the study maps as "Cones of Vision" (Fig. 37). Restricting the volume of the building in the area also meant preserving the view of the river from Pine Avenue.

The other considerations were aimed at preserving the prestige of the area with regard to land use and density, etc. The territory was divided in three distinct zones (Fig. 38) and a sliding scale for F.A.R. and site coverage was proposed. The maximum height of future buildings was fixed at 500 feet above mean sea level.

Mr. Robillard, Director of the Montreal City Planning Department, stated that:

"We believe that it is of general interest in this territory to protect existing valuable properties, prevent too many, too long

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84 Service d'Urbanisme Montreal, ZONAGE-FLANC SUD DU MONT ROYAL, March 1962.

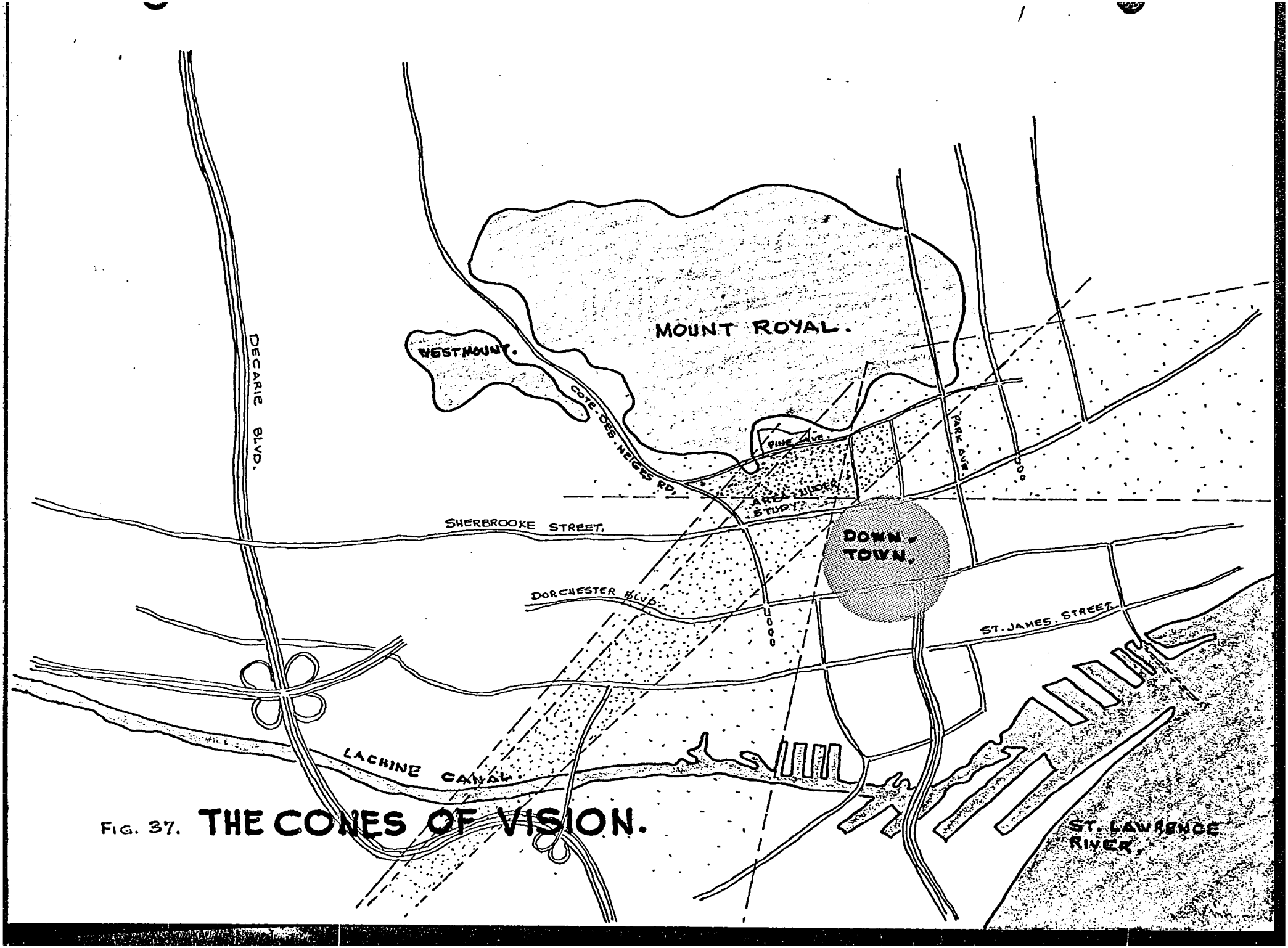

FIG. 37. THE CONES OF VISION.

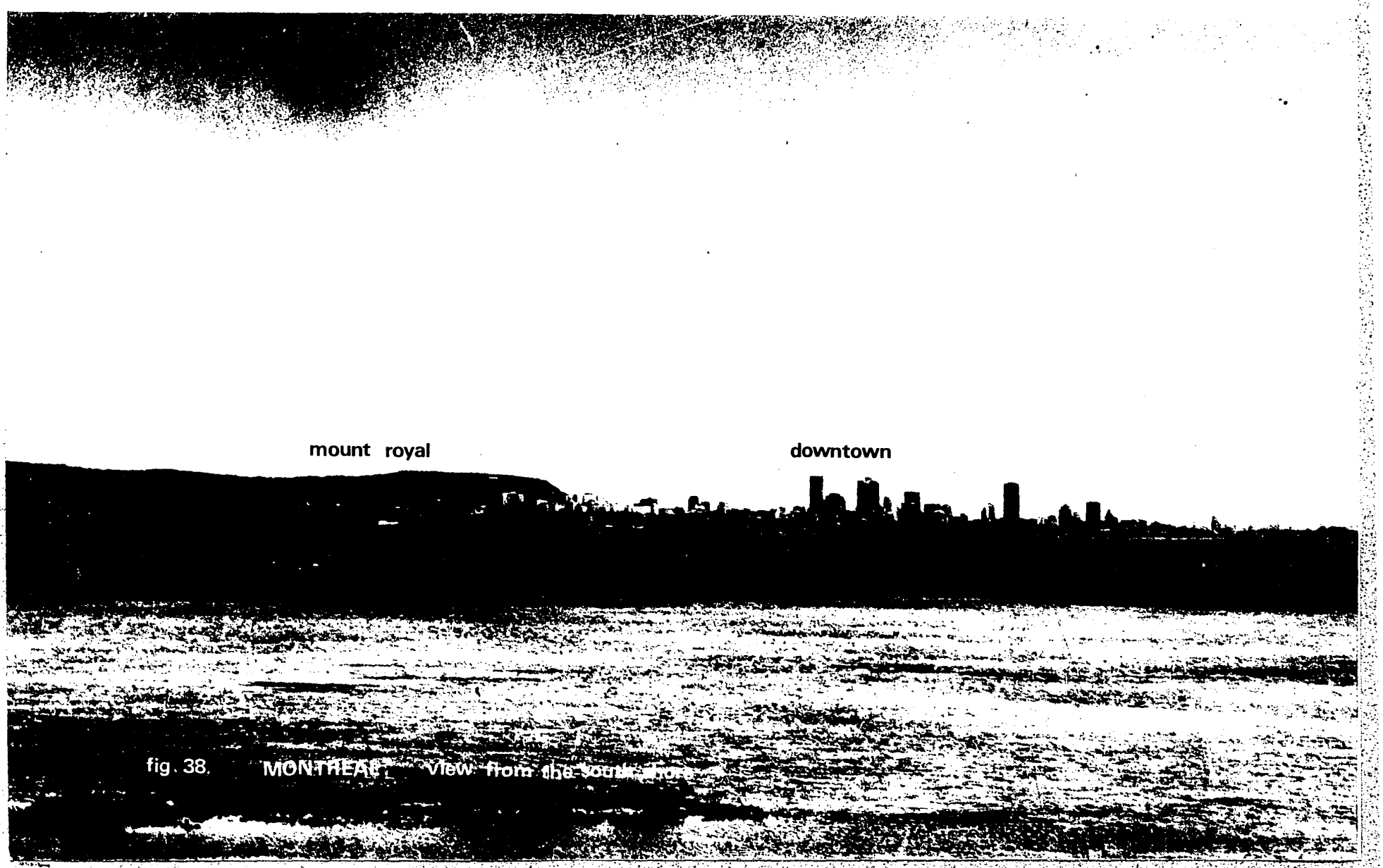

fig. 38. MONTREAL - View from the south shore

and too wide buildings.

"We think that it is more important to control density and occupancy than the height of building.

"We believe that this territory should be densely populated, that it must be occupied by residential buildings.

"The polygon earmarked for immedite study measures 4,800,000 square feet on which one-quarter is used for streets and arteries leaving about 3,600,000 square feet.

"Existing buildings on north of Sherbrooke Street include three churches, three apartment houses, one hotel, two clubs, one business office, one museum, and two vacant lots.

"Further north are 11 deluxe apartment houses, old residences now occupied by consulates, religious institutions and McGill University.

"Present commercial establishments extend up to 150 feet deep with 12.00 density. Balance area zoning imposes a 100 foot height limit at 40% land occupancy. This has been reduced to 30 feet on north of Sherbrooke Street.

"The proposals are directed to:

1. Assure the best land occupancy.
2. Establish the best density.
3. Improve street lines.
4. Encourage private enterprise to cooperate with the City in the latter's objective to provide for the general welfare."[85]

The bylaw underwent series of setbacks due to court actions, etc. as mentioned earlier, and was finally adopted by the City Council on February 1, 1963.

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85 The Montreal Star, January 11, 1962.

BYLAW NO. 2812: [86]

Scope: Applicable to the area limited by the axis of:

Sherbrooke Street

Cote des Neiges Road

Pine Avenue

McTavish Street

The above areas are divided into three zones (Fig. 39)

Zone A. Territory limited by McTavish Street, Sherbrooke Street, Cote des Neiges Road and a line located at 300 feet from north boundary of Sherbrooke Street.

Zone B. Territory limited by McTavish Street, north limit of Zone A, Cote des Neiges Road and McGregor Avenue.

Zone C. Territory limited by McTavish Street, McGregor Avenue, Cote des Neiges Road and Pine Avenue.

Occupancy: In case of apartment buildings, at least 40% of dwellings shall have a minimum area of 1,000 square feet; at least 70% of dwellings shall have a minimum area of 750 square feet and no dwelling shall have an area of less than 450 square feet.

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[86] City of Montreal, Bylaw No. 2812, February 1, 1963.

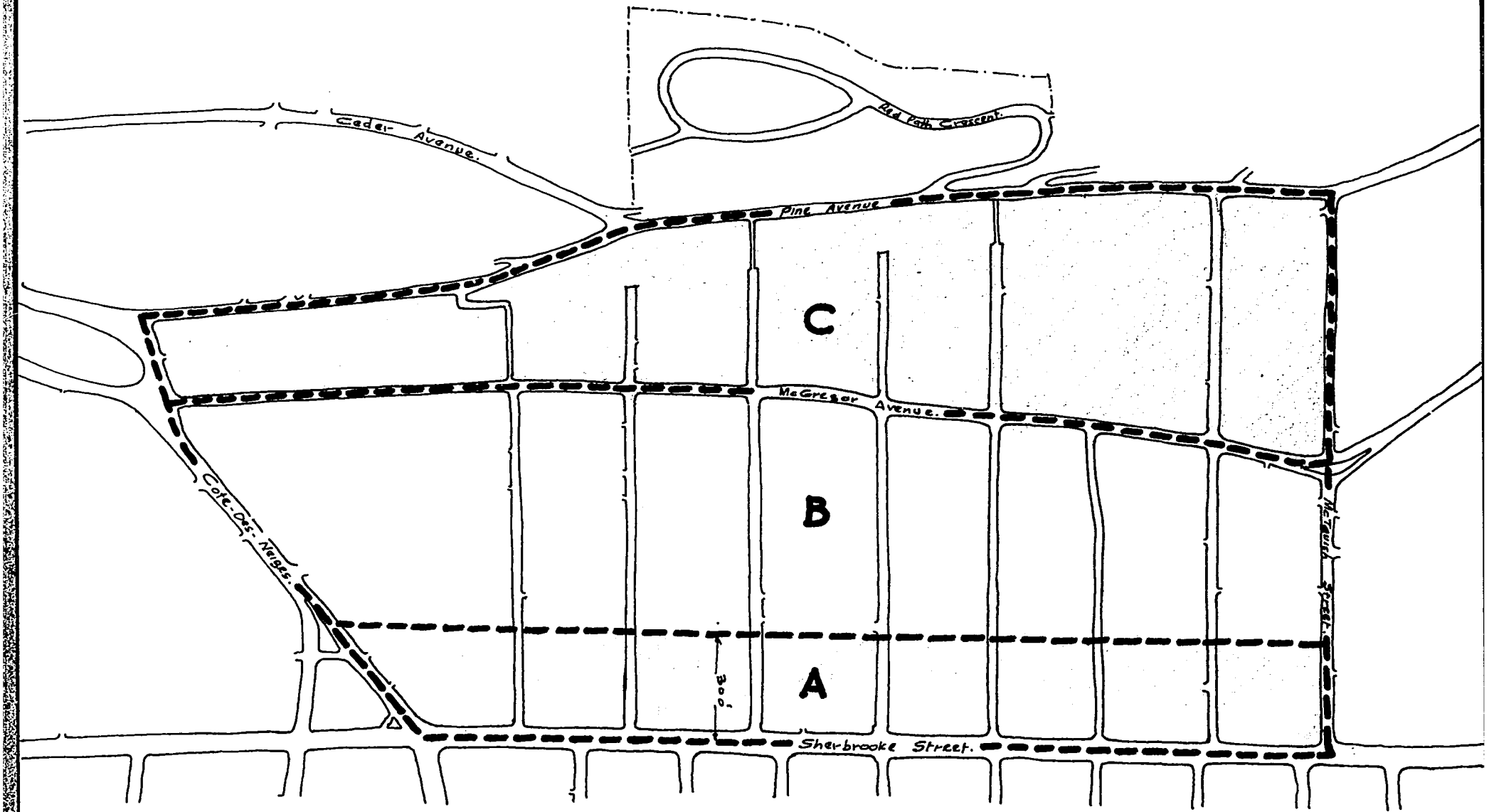

Fig. 39 THE THREE ZONES

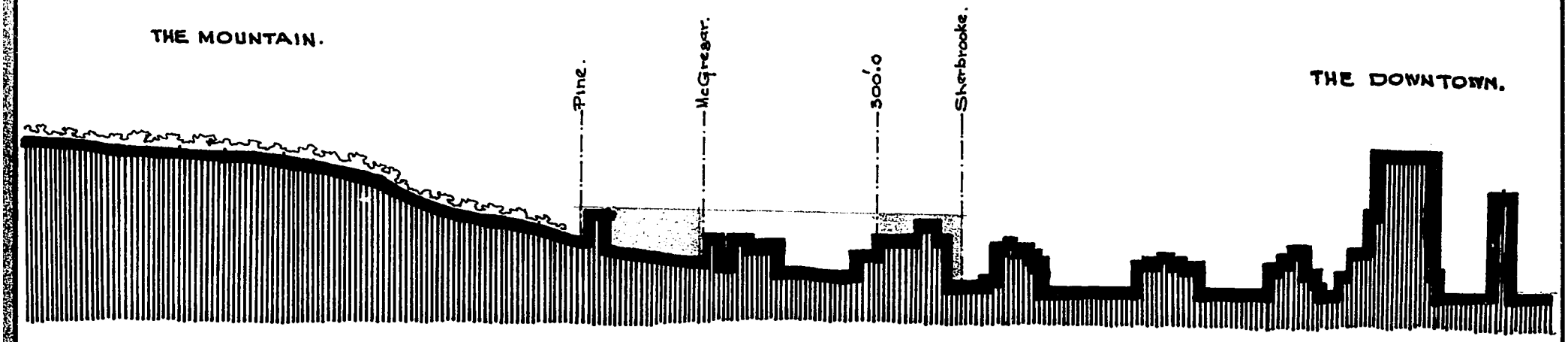

FIG. 40.

PROFILE.

Construction:

b. Max. volume:

shall not exceed 12 times the maximum floor area:

(Ref. Table p.)

c. Max. land coverage:

shall not exceed 60% of area of lot.

(Ref. Table p.)

d. Max. height:

shall not rise to height of more than 500 feet above mean sea level (Fig. 40).

Setbacks:

a. A function of the height and length of the building.

b. Setback distance in relation to height DH:

Formula: $DH = 2.5\sqrt{H - 10.}$

where H - Height

D - Distance

L - Length

at least a setback of 10 feet is required.

c. Setback distance in relation to length.

Formula: $DL = \frac{(L - 125)2}{25}$

The final setback to be determined with formula:

$$D = DH + DL$$

ZONE A

FLOOR SPACE INDEXES

Area of the "lot" in square feet	LAND COVERAGE OF THE BODY OF THE BUILDING							
	25%	30%	35%	40%	45%	50%	55%	60%
1000	0	0	0	0	0	0	0	0
2000	1.204	1.102	1.003	0.903	0.826	0.752	0.669	0.602
3000	1.908	1.748	1.590	1.433	1.311	1.193	1.060	0.954
4000	2.408	2.205	2.007	1.808	1.654	1.505	1.338	1.204
5000	2.796	2.560	2.330	2.099	1.920	1.747	1.553	1.398
6000	3.112	2.850	2.594	2.337	2.138	1.945	1.729	1.556
7000	3.380	3.096	2.817	2.538	2.322	2.113	1.878	1.690
8000	3.612	3.308	3.010	2.712	2.481	2.257	2.007	1.806
9000	3.817	3.495	3.181	2.865	2.621	2.385	2.120	1.908
10000	4.	3.663	3.333	3.003	2.747	2.500	2.222	2.000
11000	4.165	3.814	3.471	3.127	2.861	2.603	2.314	2.083
12000	4.316	3.953	3.597	3.240	2.964	2.698	2.398	2.158
13000	4.456	4.080	3.713	3.345	3.060	2.785	2.475	2.228
14000	4.584	4.198	3.820	3.442	3.149	2.865	2.547	2.292
15000	4.704	4.308	3.920	3.531	3.231	2.940	2.613	2.352
16000	4.816	4.411	4.014	3.616	3.308	3.010	2.676	2.408
17000	4.922	4.507	4.101	3.694	3.380	3.076	2.734	2.461
18000	5.021	4.598	4.184	3.769	3.448	3.138	2.789	2.510
19000	5.115	4.684	4.262	3.840	3.513	3.197	2.842	2.557

Area of the "lot" in square feet	LAND COVERAGE OF THE BODY OF THE BUILDING							
	25%	30%	35%	40%	45%	50%	55%	60%
20000	5.204	4.766	4.337	3.907	3.574	3.253	2.891	2.602
25000	5.592	5.121	4.660	4.198	3.840	3.495	3.106	2.796
30000	5.908	5.411	4.924	4.436	4.058	3.693	3.282	2.954
35000	6.176	5.656	5.147	4.637	4.242	3.860	3.431	3.088
40000	6.408	5.868	5.340	4.811	4.401	4.005	3.560	3.204
45000	6.613	6.056	5.511	4.965	4.542	4.133	3.674	3.306
50000	6.798	6.223	5.663	5.102	4.667	4.247	3.775	3.398
55000	6.961	6.375	5.801	5.226	4.781	4.351	3.867	3.481
60000	7.112	6.513	5.927	5.340	4.885	4.445	3.951	3.556
65000	7.252	6.641	6.043	5.444	4.980	4.532	4.029	3.626
70000	7.380	6.759	6.150	5.541	5.069	4.613	4.100	3.690
75000	7.500	6.868	6.250	5.631	5.151	4.687	4.167	3.750
80000	7.612	6.971	6.343	5.715	5.228	4.758	4.229	3.806
85000	7.718	7.067	6.431	5.794	5.301	4.824	4.288	3.859
90000	7.817	7.158	6.514	5.868	5.369	4.886	4.343	3.908
95000	7.911	7.244	6.592	5.939	5.433	4.944	4.395	3.955
100000	8.000	7.326	6.667	6.006	5.495	5.000	4.444	4.000
& plus								

ZONE B

FLOOR SPACE INDEXES

Area of the "lot" in square feet	LAND COVERAGE OF THE BODY OF THE BUILDING							
	25%	30%	35%	40%	45%	50%	55%	60%
1000	0	0	0	0	0	0	0	0
2000	0.903	0.805	0.700	0.602	0.528	0.456	0.376	0.301
3000	1.433	1.276	1.110	0.954	0.837	0.723	0.596	0.477
4000	1.808	1.610	1.400	1.204	1.056	0.912	0.752	0.602
5000	2.099	1.869	1.625	1.398	1.226	1.059	0.874	0.698
6000	2.337	2.080	1.810	1.556	1.365	1.179	0.973	0.778
7000	2.538	2.260	1.965	1.690	1.483	1.280	1.056	0.845
8000	2.712	2.414	2.100	1.806	1.584	1.368	1.129	0.903
9000	2.865	2.551	2.219	1.908	1.674	1.446	1.193	0.954
10000	3.003	2.674	2.326	2.000	1.754	1.515	1.250	1.000
11000	3.127	2.784	2.422	2.083	1.827	1.578	1.302	1.041
12000	3.240	2.885	2.510	2.158	1.893	1.635	1.349	1.079
13000	3.345	2.978	2.590	2.228	1.954	1.688	1.392	1.114
14000	3.442	3.064	2.665	2.292	2.011	1.737	1.433	1.146
15000	3.531	3.144	2.735	2.352	2.063	1.782	1.470	1.176
16000	3.616	3.220	2.800	2.408	2.112	1.824	1.505	1.204
17000	3.694	3.290	2.861	2.461	2.159	1.864	1.538	1.230
18000	3.769	3.356	2.919	2.510	2.202	1.902	1.569	1.255
19000	3.840	3.419	2.974	2.557	2.243	1.937	1.598	1.279

Area of the "lot" in square feet	LAND COVERAGE OF THE BODY OF THE BUILDING							
	25%	30%	35%	40%	45%	50%	55%	60%
20000	3.907	3.479	3.026	2.602	2.282	1.971	1.626	1.301
25000	4.198	3.738	3.251	2.796	2.452	2.118	1.747	1.398
30000	4.436	3.949	3.435	2.954	2.591	2.238	1.846	1.477
35000	4.637	4.128	3.591	3.088	2.709	2.339	1.930	1.544
40000	4.811	4.283	3.726	3.204	2.811	2.427	2.003	1.602
45000	4.965	4.420	3.845	3.306	2.900	2.505	2.067	1.653
50000	5.102	4.543	3.951	3.398	2.981	2.574	2.124	1.699
55000	5.226	4.653	4.047	3.481	3.053	2.637	2.175	1.740
60000	5.340	4.754	4.135	3.556	3.119	2.694	2.223	1.778
65000	5.444	4.847	4.216	3.626	3.181	2.747	2.266	1.813
70000	5.541	4.933	4.291	3.690	3.237	2.796	2.306	1.845
75000	5.631	5.013	4.360	3.750	3.289	2.841	2.344	1.875
80000	5.715	5.088	4.426	3.806	3.339	2.883	2.379	1.903
85000	5.794	5.159	4.487	3.859	3.385	2.923	2.412	1.929
90000	5.868	5.225	4.545	3.908	3.428	2.961	2.443	1.954
95000	5.939	5.288	4.599	3.955	3.470	2.997	2.472	1.977
100000	6.000	5.348	4.651	4.000	3.509	3.030	2.500	2.000
& plus								

ZONE C

FLOOR SPACE INDEXES

Area of the "lot" in square feet	LAND COVERAGE OF THE BODY OF THE BUILDING							
	25%	30%	35%	40%	45%	50%	55%	60%
1000	0	0	0	0	0	0	0	0
2000	0.456	0.401	0.351	0.301	0.261	0.225	0.188	0.151
3000	0.723	0.636	0.557	0.477	0.415	0.356	0.298	0.239
4000	0.912	0.803	0.702	0.602	0.523	0.449	0.376	0.301
5000	1.059	0.932	0.815	0.698	0.608	0.522	0.437	0.349
6000	1.179	1.037	0.908	0.778	0.677	0.581	0.486	0.389
7000	1.280	1.127	0.986	0.845	0.735	0.631	0.528	0.423
8000	1.368	1.204	1.054	0.903	0.785	0.674	0.564	0.452
9000	1.446	1.272	1.113	0.954	0.830	0.712	0.596	0.477
10000	1.515	1.333	1.167	1.000	0.869	0.746	0.625	0.500
11000	1.578	1.388	1.215	1.041	0.905	0.777	0.651	0.521
12000	1.635	1.439	1.259	1.079	0.938	0.805	0.674	0.540
13000	1.688	1.485	1.300	1.114	0.969	0.831	0.696	0.557
14000	1.737	1.528	1.337	1.146	0.997	0.855	0.716	0.573
15000	1.782	1.568	1.372	1.176	1.023	0.878	0.735	0.588
16000	1.824	1.605	1.405	1.204	1.047	0.899	0.753	0.602
17000	1.864	1.641	1.436	1.230	1.070	0.918	0.769	0.615
18000	1.902	1.674	1.465	1.255	1.091	0.937	0.785	0.628
19000	1.937	1.705	1.492	1.279	1.112	0.954	0.799	0.639

Area of the "lot" in square feet	LAND COVERAGE OF THE BODY OF THE BUILDING							
	25%	30%	35%	40%	45%	50%	55%	60%
20000	1.971	1.735	1.518	1.301	1.131	0.971	0.813	0.651
25000	2.118	1.864	1.631	1.398	1.216	1.043	0.874	0.699
30000	2.238	1.969	1.724	1.477	1.284	1.102	0.923	0.739
35000	2.339	2.059	1.802	1.544	1.343	1.152	0.965	0.772
40000	2.427	2.136	1.869	1.602	1.393	1.196	1.001	0.801
45000	2.505	2.204	1.929	1.653	1.438	1.234	1.033	0.827
50000	2.574	2.265	1.982	1.699	1.477	1.268	1.062	0.849
55000	2.637	2.320	2.031	1.740	1.513	1.299	1.088	0.870
60000	2.694	2.371	2.075	1.778	1.546	1.327	1.111	0.889
65000	2.747	2.417	2.115	1.813	1.576	1.353	1.133	0.906
70000	2.796	2.460	2.153	1.845	1.604	1.377	1.153	0.923
75000	2.841	2.500	2.188	1.875	1.630	1.399	1.172	0.938
80000	2.883	2.537	2.221	1.903	1.655	1.420	1.189	0.952
85000	2.923	2.573	2.251	1.929	1.678	1.440	1.206	0.965
90000	2.961	2.606	2.280	1.954	1.699	1.458	1.221	0.977
95000	2.997	2.637	2.308	1.977	1.720	1.476	1.236	0.989
100000	3.000	2.667	2.334	2.000	1.739	1.493	1.250	1.000
& plus								

RECENT DEVELOPMENTS:

The primary function of Bylaw No. 2812 was to encourage taller buildings with minimum coverage so that maximum air space could be left around the new developments. This would have allowed uninterrupted view to and from the mountain at certain locations. However, the buildings constructed during this period indicated two different approaches which the development could take under the new framework. Also, some of the lots especially on longitudinal streets were more adept to long slab type structures in order to maximize the site frontage benefits. The incentive for land assembly could be detrimental all the more in such cases which could result in the reversal of original objectives.

Whereas Stanley Tower apartment building (Fig. 41) portrays the City's idea of development, the construction of Place Elgin apartment building (Fig. 42) parallel to McGregor Street and spanning the full length of the lot was, therefore, instrumental in starting a new chain of ideas in the City Planning Department. The proposed modifications were contained in a report from City Planning Director, Aime Desautels:

> "Our survey", he informed Council, "has led us to conclude that we must review our initial positions and set

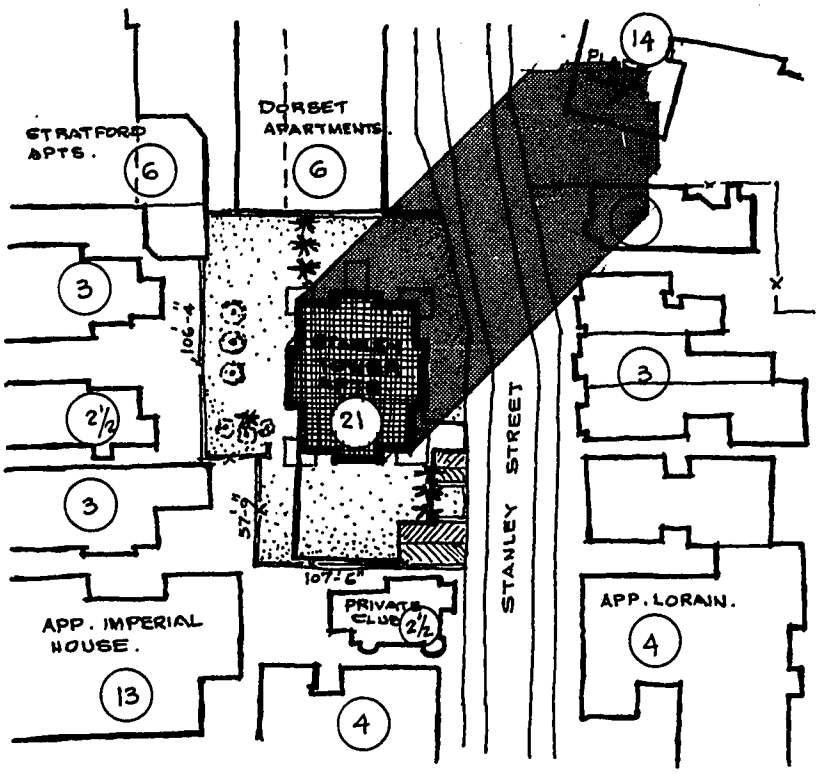

Fig. 41. STANLEY TOWER APARTMENTS. (Bylaw No.2812)
3470 Stanley Street

1)	Year of construction	1965
2)	Area of lot	20,422 sq. ft.
3)	Coverage on Main Floor	4,620 sq. ft.
4)	F. A. R.	4.816
5)	Number of floors	21
6)	Height	216 (319.75 above m.s.l.)

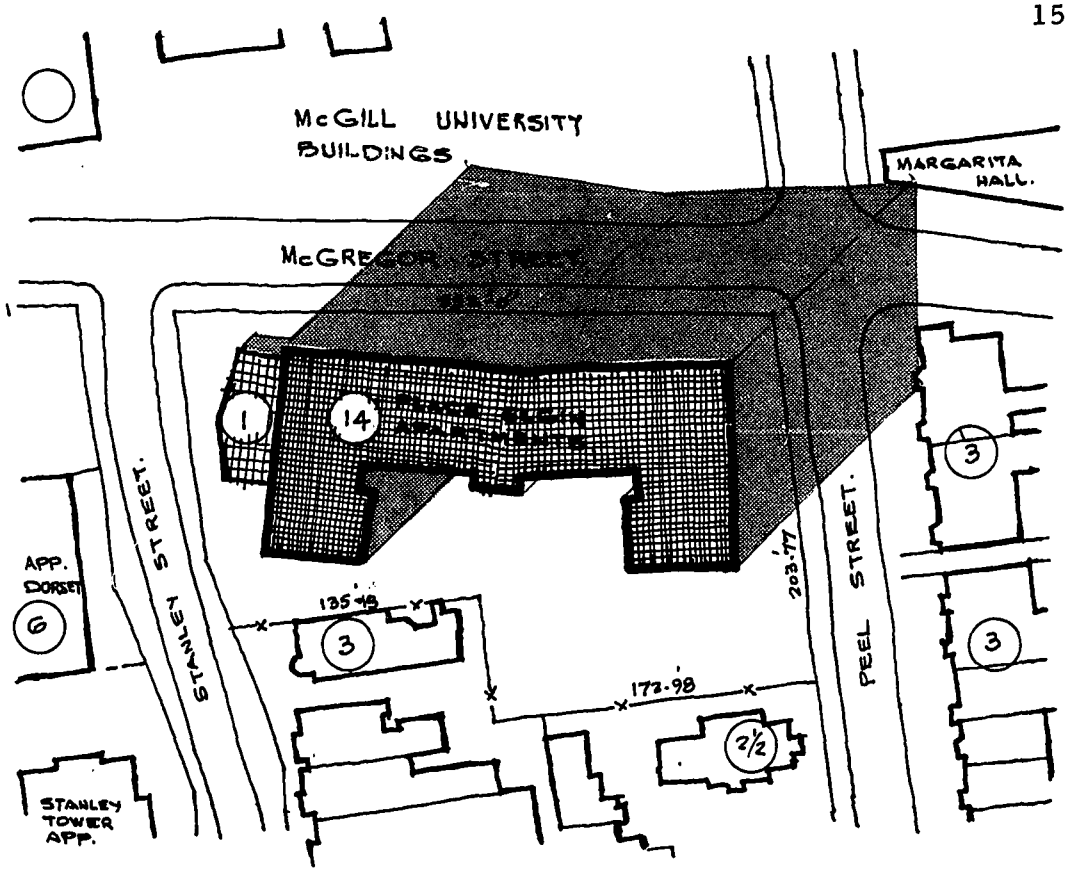

Fig. 42. PLACE ELGIN APARTMENTS. (Bylaw No. 2812)
110 McGregor Avenue

1)	Year of construction	1967
2)	Area of lot	60,873 sq. ft.
3)	Coverage on Main Floor	19,473.75 sq. ft.
4)	F. A. R.	4.522
5)	Number of floors	14
6)	Height	135'-0"

> levels and limits offering a greater variety more directly linked with the character of each site, limit the land coverage of buildings and require that broad clearance be provided between each building and between each separate part of the same building."

Mr. Desautels deplored some of the structures put up in the last five years since the first zoning was enacted. These constitute obstacles to the purpose of bylaw No. 2812 and 2905.[87]

---

[87] The Montreal Star, July 26, 1968.

BYLAW NO. 3722[88]

This is the most recent bylaw enacted by the City with respect to the territory bounded by Sherbrooke Street, McTavish Street, Pine Avenue and Cote des Neiges Road, among other areas.

This particular area has been allocated for mostly residential and some commercial development along Sherbrooke Street in which only detached buildings are authorized.

F.A.R. 6 times the area of the lot.

Setbacks: Laterial setbacks:

10 feet + 1 foot & 6 inches/storey over two.

Rear setbacks:

10 feet + 2 feet & 6 inches/storey above three.

Minimum distance from rear boundary 25 feet.

Maximum Lenth of Building: Shall not be more than 175 feet between any two points about 35 feet of its height.

Land Coverage: Maximum 60% of the lot.

Minimum Area of Dwellings: No dwelling shall have a floor area of less than 250 square feet.

Maximum Height: Maximum 380 feet above m.s.l. (ref. Fig.44)

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[88] City of Montreal, Bylaw No. 3722, September 30, 1968.

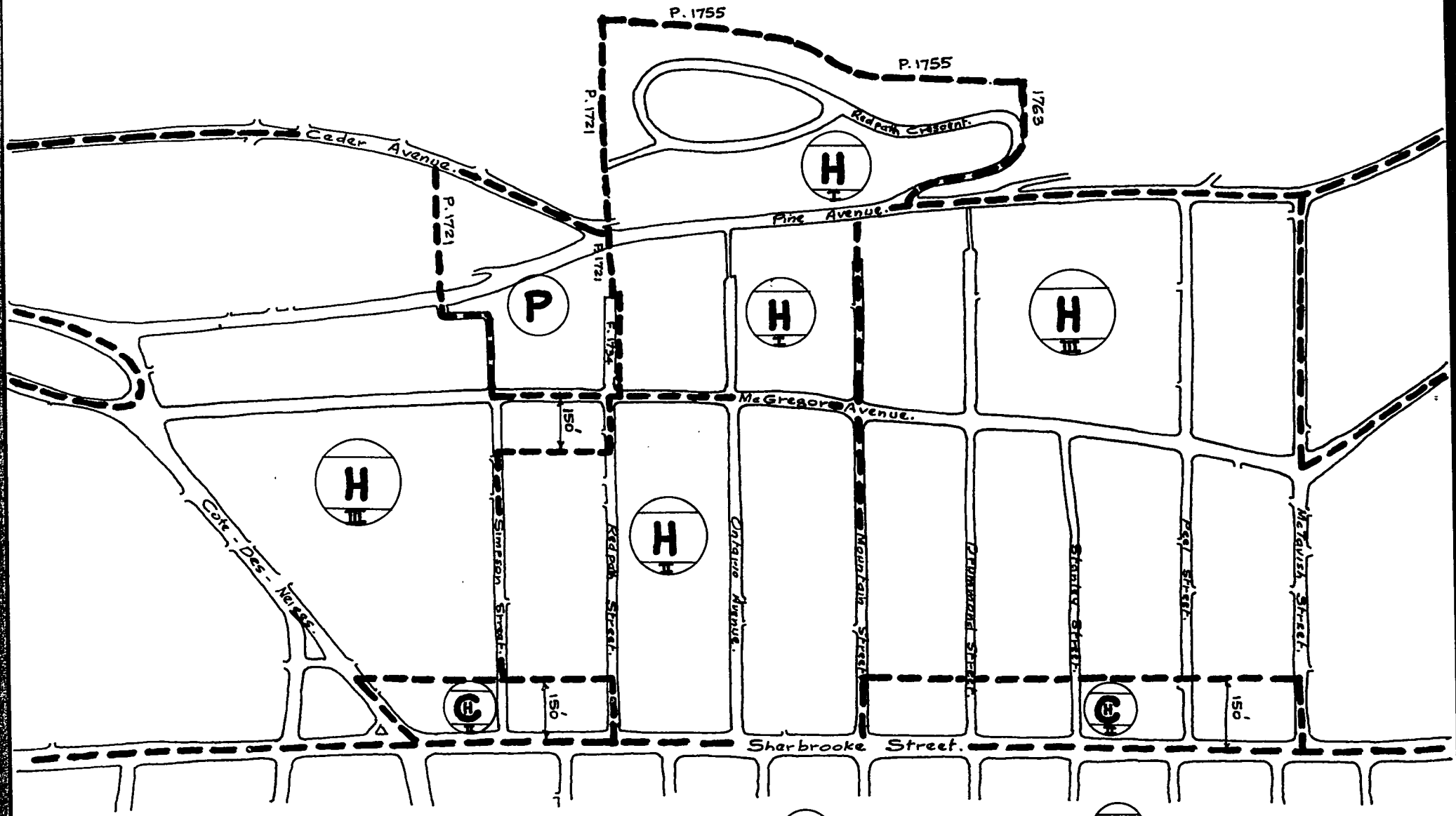

Fig. 43. **OCCUPANCY ZONES.**

BY-LAW. 3722.

H — SINGLE DWELLING.

H — MULTIPLE DWELLING.

H — MULTIPLE DWELLING. DETATCHED.

C — RESIDENTIAL AND COMMERCIAL.

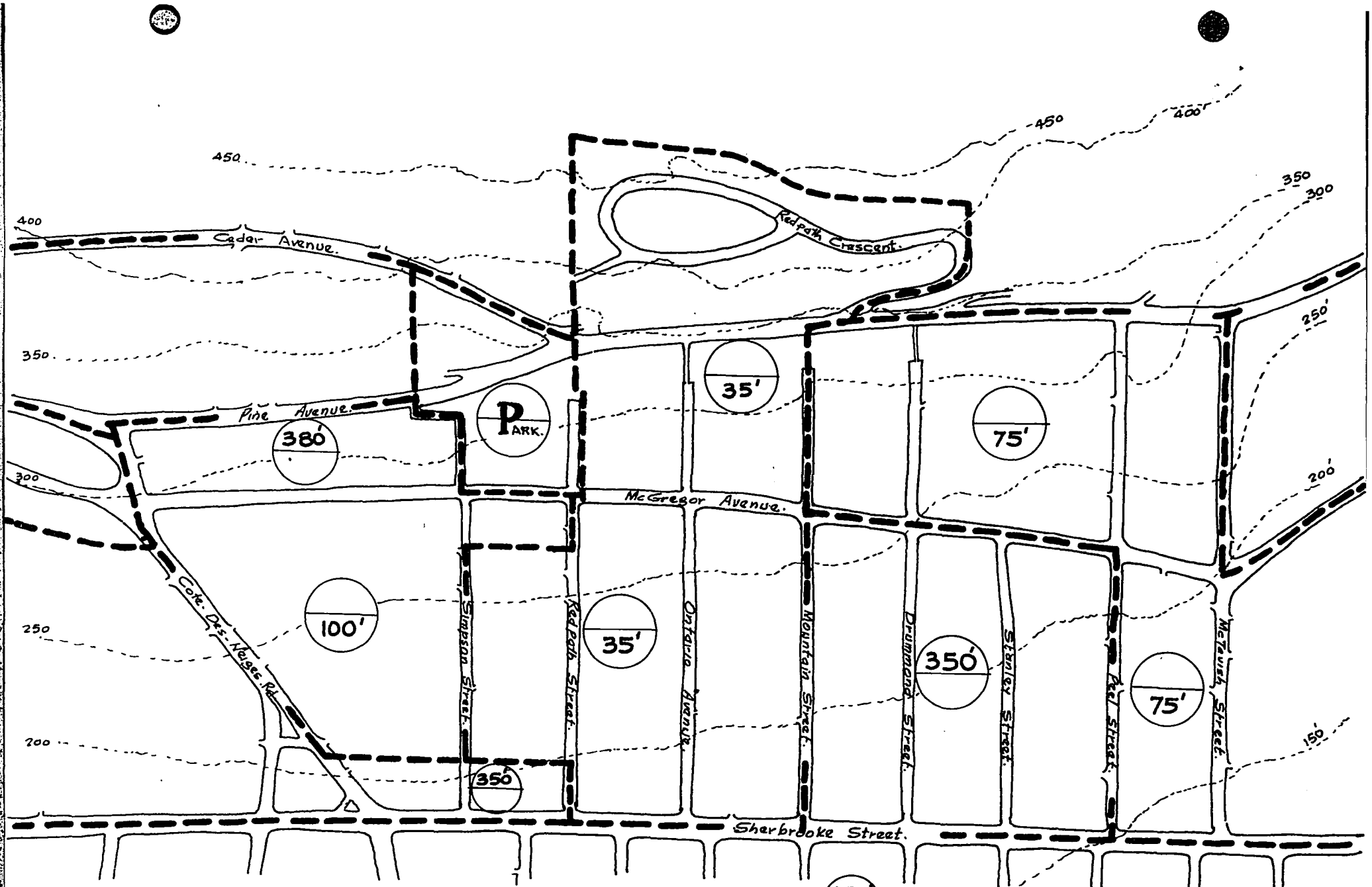

FIG. 44. **HEIGHT ZONES.** BY-LAW. 3722.

000' MAX. HEIGHT ABOVE MEAN SEA LEVEL.

000' MAX. HEIGHT OF BUILDING.

OBSERVATIONS:

It is evident from the study of bylaws that the Authorities recognized the special significance of the area with respect to its juxtaposition with the city core, as well as its relationship to the Mountain. Bylaw No. 2812 introduced radical changes in the existing regulations. The permissible volume of buildings was not only considerably reduced, but an element of sliding scale for F. A. R. for different sizes of lots was incorporated. The smaller lots could not enjoy the same F. A. R. as the larger lots and higher F. A. R. was allowed against a corresponding reduction in floor coverage. The territory was also divided in three distinct sectors with different land use and volume of construction. The maximum height allowed in all the sectors being 500 feet above mean sea level.

The provision of sliding scale for F. A. R. can be compared to the principle of 'bonus' or 'premium' and was designed to create incentive for developers to leave sufficient open space around structures, and build tall and slender towers to ensure a visual link with the mountain from various points in the City. Another important element of these regulations was the incentive for land assembly in the form of greater permissible volume of construction on larger piece of land.

Whereas the general public welcomed these measures designed to save the mountain, property owners and developers opposed enactment of the bylaw. They feared decline in property values as a direct result of reduced volume of construction permitted by the new regulations.

Peelbrooke Development Corporation and Redbrooke Estates Ltd. were the principal developers protesting various provisions of the bylaw , and wanted the City Authorities to relate the permissible volume with the prevailing price of land. A brief submitted by the two companies in connection with the proposed Port Royal apartment project and Le Cartier apartment project pointed out many shortcomings in the bylaw. An analysis of the pattern of land available for development with respect to fixed elements and land under powers of expropriation by McGill University, states:

> "In Zone 'A' such area amounts to 59.4%, Zone 'B' 53.2% and in Zone 'C' to 62.5%.
>
> "In the remaining area 86% of all lots are less than 10,000 square feet - only 24 lots exceed 20,000 square feet and only 3 measure above 40,000 square feet. Thus few lots of sufficient size are available for the primary objectives of the bylaw.
>
> "The lots measuring less than 20,000 in Zone 'A', 11 out of 25 lots are in transition, in Zone 'B' 27 of 28 are in transition and in Zone 'C' 24 of 69 lots are in transition.

Thus in total, about 33% of lots are in transition.

"In respect of lots over 20,000 square feet, studies reveal that in Zone 'B' only 2 lots are in transition."[89]

The basic objective of the submission was to point out the relationship of the existing size of lots and the impracticability of the bylaw to promote construction in the area under existing conditions. The brief further states:

"The development over last decade points out that parcels of land most commonly used for apartment buildings, measure between 15,000 to 20,000 square feet. An analysis of the existing conditions indicatesthere might well be 60 such parcels of 20,000 square feet, 10 of about 30,000 square feet, and 3 with more than 40,000 square feet area."[90]

The bylaw, therefore, did not primarily deal with lots of average size, but was aimed at larger lots. The developers argued that an economical layout of apartment floor requires a minimum of 7,500 square feet. This area would need 30,000 square feet of lot area with 25% coverage in order to get optimum results. As lot areas of this size were very rare, no development would prove profitable without land assembly.

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[89] Peelbrooke Development Corporation & Redbrooke Estates Ltd., A Brief Submitted to Appeal Against the Provisions of Proposed Bylaw, May 15, 1962.

[90] Ibid.

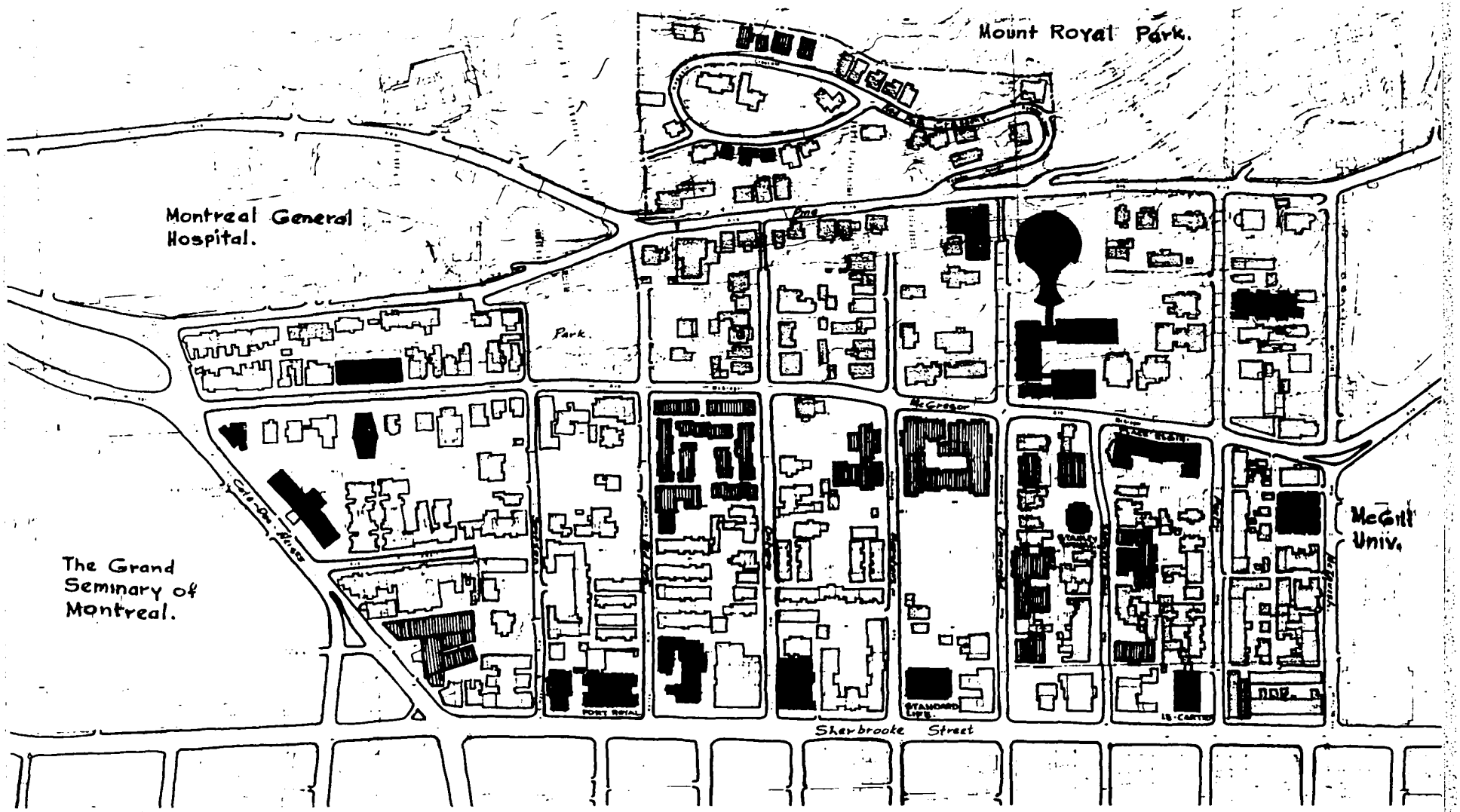

FIG. 45. **EXISTING PATTERN.**

The relationship of land values and F. A. R. was explained in detail on the basis of current land prices and rates of construction. Its summary by the City Planning Department reads:

> "It is assumed that an investor requires a net return of 10% on his investment in buildings. Building cost per square foot is assumed as $12.00 for high rise and $11.00 for low rise apartment buildings. It is further assumed that gross revenue per square foot of building averages $2.25 and that net revenue averages 60% of gross or $1.35 per square foot of building. As the 10% demanded by the investor amounts to $1.20 or $1.10 respectively, the residual revenue available for land amounts to 15 c. or 25 c. for high or low buildings respectively. Capitalizing the revenue at 6.5% the resulting value of land is found to be $2.31 or $3.85 for every square foot of building for every square foot of land. The value of land, thus becomes a straight line function of the floor space index."[91]

Another brief by Mr. I. Rudberg of Mountain Place Ltd. also dealt with the relationship of land prices and the volume of construction. The postulates assumed by him were that the cost of building should be eight times the value of land in order to justify cost of land and equity to invest. It stated that:[92]

> "Average value of land in the various zones can be summarized as follows:

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[91] Ibid.

[92] I. Rudberg, Mountain Place Ltd., A Brief to Appeal Against The Provisions of Proposed Bylaw.

Zone 'A'	$30.00/square foot
Zone 'B'	$20.00/square foot
Zone 'C'	$10.00/square foot

"The cost of good type of construction should amount to $15.00 and therefore:

Table to Arrive at F. S. I.

Zone	Value of Construction Based on 8 Times Land Value	Empirical F. S. I. Based on Construction Cost
'A'	$30 x 8 = $240	$240/15 = 16
'B'	$20 x 8 = $160	$160/15 = 10.10
'C'	$10 x 8 = $ 80	$ 80/15 = 5.33

The City Planning Department came up with their own calculations and justified the economics of construction based on 2/3 mortgage normally available to developers at 7.5%. Their projections are supported by the fact that five apartment buildings were constructed within the scope of this bylaw in the five-year period between 1963 - 68.

The incentive for land assembly, though designed to create big parcels of land with large open areas around the structures, involved many difficulties on the part of developers. The City Authorities did not have powers for land expropriation to aid in such ventures, in a way to achieve the objectives. Left to the desires of the property owners, such land assembly could prove contrary to basic planning concepts. Furthermore, there were

no restrictions with regard to the lateral dimensions of structures. Contrary to the construction of two long slab-type structures of several storeys height, and spanning full width of city block (Regency Apartments on Cote des Neiges Road and Place Elgin on McGregor Avenue) under the provisions of this bylaw, were therefore instrumental in pointing out the inefficiency of the bylaw to the City Authorities.

The provisions of Bylaw No. 3722 indicate a complete change in the basic concepts of the City Planning Department. It allows a maximum F. A. R. of 6.00 and aims at achieving its objectives through restricting the height and width of buildings above 35 feet height. The commercial land use formally represented by Zone 'A' along Sherbrooke Street was reduced to 150 feet. It is further interspersed between Mountain and Redpath Streets by single family dwelling district with an ultimate idea to create a swath from Pine Avenue down to the river for unobstructed views. This seems too ambitious and rather impractical.

About 30% of the territory is meant for single family dwellings with a maximum permissible height of 35 feet, whereas the multiple dwelling district is permitted to rise up to 75 feet above grade. It is evident that maximum F. A. R. cannot be utilized in these areas in view of maximum height, coverage and setback restrictions. The permissible building volume being

related to land prices, the present regulations are bound to result in decline of land prices. According to figures obtained from Royal Trust Company[93], the market price of land between Pine and McGregor within limits of "Single Family Dwelling District", has shown a decline from $10.00 to $6.00 per square foot. The land prices on the north side of Sherbrooke Street have declined with respect to parcels of land on southern side of the street, after the enactment of Bylaw No. 2812, but no change is recorded in this area after the enactment of the current Bylaw No. 3722.

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[93]Mr. Robert Wiley, Assessor, Royal Trust Company, Montreal

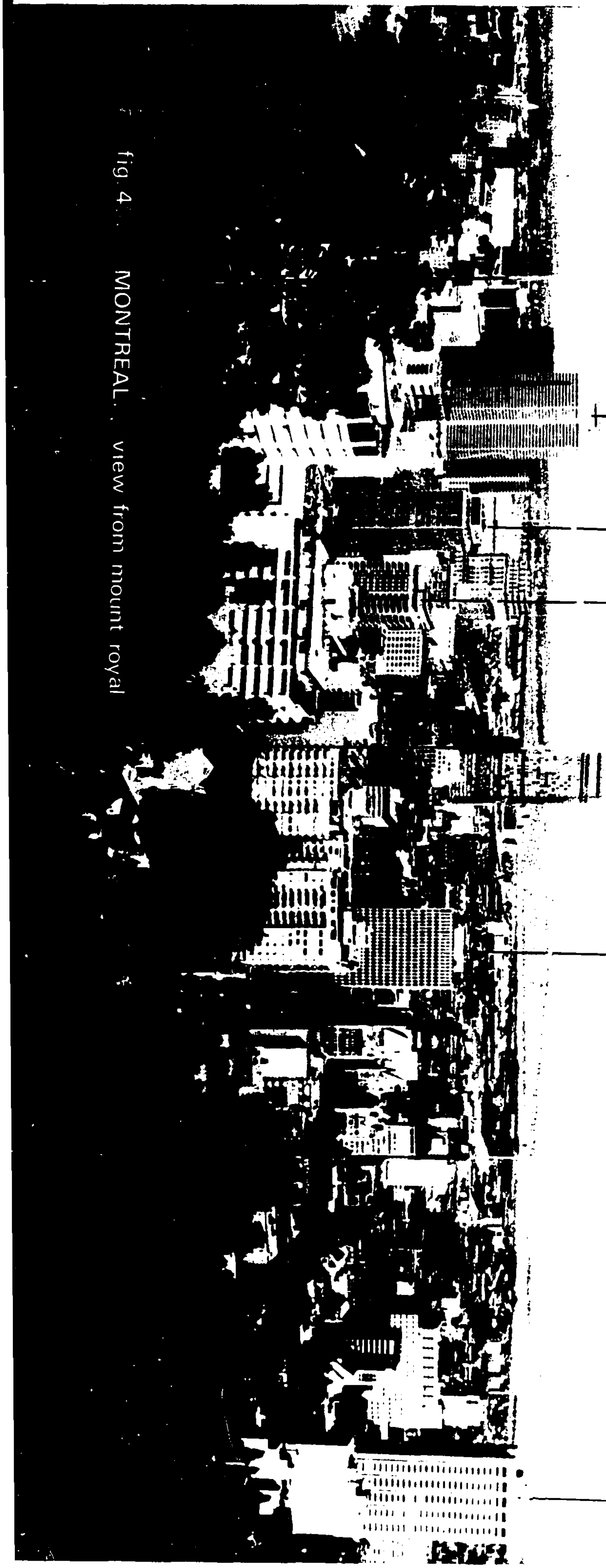

fig 4 . MONTREAL . view from mount royal

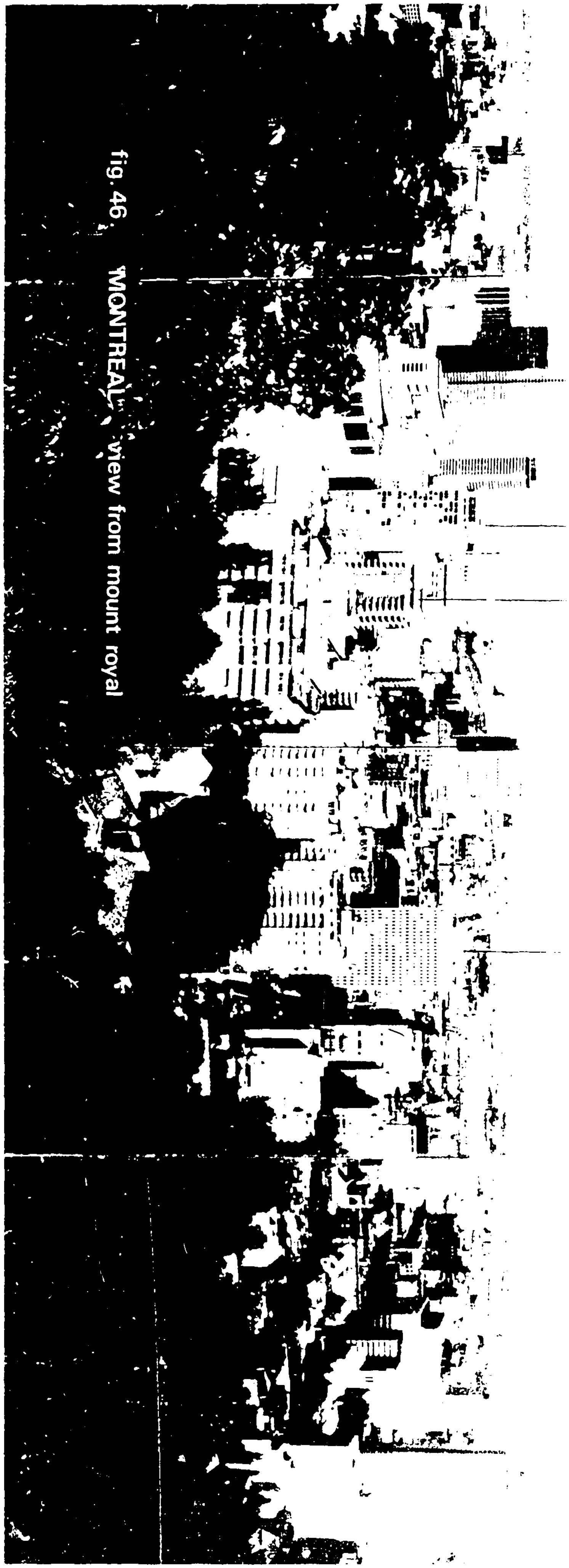

fig. 46. MONTREAL view from mount royal

PART III

Chapter V CONCLUSIONS

CONCLUSIONS:

Zoning regulations, used as an instrument to control our urban environment, have become an important part in the growth of our cities. In this study I have tried to trace the meaning and function of such regulations dealing with the various problems of high density areas. The study describes the evolution of zoning regulations along with their effects on the resulting form of structures. The study of various elements; i.e. daylight, sunlight, urban microclimate, etc., governing the form and relationship of structures, shows the extent of research done so far in these fields. It is also evident that, due to lack of supporting scientific data, such research has not found much favour in the formation of zoning regulations in North American cities. The history of bulk controls, therefore, portrays the evolution of zoning regulations on empirical basis, as a result of the interaction between political, geographic, social and economic forces.

The particular aspect of these regulations which conerned me was the application of bulk controls designed to achieve aesthetic results. For this reason, the study of the area on the southern flank of Mount Royal in Montreal offered an excellent example. The study shows the symbolic value of a mountain in the heart of the city, and the evolution of bulk controls indicates

the unending struggle between City Authorities and private enterprise, in order to save this principal open space, and prevent haphazard development.

Unlike some other North American cities, the civic authorities of Montreal are equipped with vast legislative powers to control land use, density and aesthetics, etc., in order to achieve desired results. The Cities and Towns Act of the Province of Quebec states that:

> ".....to classify, for purposes of regulation, dwellings, commercial establishments, industrial establishments and all other immoveables, including public buildings; to regulate the places where each category of the aforesaid structures may be situated; to divide the municipality into zones of such number, shape and area as the council deems suitable for the purpose of such regulation and, with respect to each of such zones, to prescribe the architecture, dimensions, symmetry, alignment and destination of the structures which may be erected therein, the use of any immoveable located therein, the area and dimensions of lots, the proportion of lots which may be occupied by structures, the space which must be left clear between structures and the lines of lots, the space which, on such lots, must be reserved and arranged for the parking..."[94]

The mountain has been a source of inspiration, pride and an important recreation area for Montrealers as early as 1874. The fear of losing this important amenity to private development had resulted in the public authorities' acquisition of what is now

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[94]Revised Statues of Quebec: Cities & Towns Act, 1964, Article 426.

Mount Royal Park. Its importance at the time is evidenced by the fact that the City Authorities engaged an eminent landscape architect, Mr. F. L. Olmstead of New York for its design.[95] Since the northern slopes were already used as cemetery grounds, only the southern and eastern sides were utilized for the Park. In order to restrict the use of surplus cemetery land, the charter of Cemetery Companies stated that:

> "Land allotted to such company shall be used as a cemetery forever and not alienable to any other use, unless change shown is desirable and to the satisfaction of Lt. Governor."[96]

However, the Mount Royal Cemetery Company which had been incorporated under the above charter had its provisions amended in 1914, which read:

> "The said company is hereby authorized to sell, when the trustees may deem it expedient, such portion or portions of the land or immoveable property of the company as has not been sold or disposed of for burial purposes.
>
> "The company may develop its immoveable property within the limits of the town of Outremont, being part of lot No. 8 and that part of lot No. 9 on the official plan and book of reference of the parish of Montreal, which is not now used for burial purposes; may plan, subdivide and lay out said

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[95] Public Works Dept. File on Mount Royal Park: History

[96] Statutes of Quebec, 33-35; Vict. 1870; Chap. XXXI, Articles 1 - 12.

> property and establish streets, park-ways, lanes and squares thereon, which streets and park-ways may with the consent of the council of the said town be of a width of less than sixty-six feet; may gratuitously cede such streets, park-ways and lanes to the town; may acquire the adjacent property not exceeding ten acres in extent..."[97]

The amendment was instrumental in providing private developers access to the formerly restricted open areas, and thus jeopardized the original intent of public authorities - to protect the important open space for the benefit of the general public.

Due to the unique position of the mountain, the land around it was regarded as a prestigious residential area. The southern slopes became a choice location offering many advantages of plenty of sun in a cold climate, protection from cold winds from north, view of St. Lawrence River and proximity to the downtown area. These considerations attracted the early English settlers and with the passage of time, the area became well sought-after residential location. The ownership of the land has remained with the English aristocracy representing a strong and vigorous force - the English power.

A sudden boom in construction activity in the heart of the City at the turn of the last decade eventually led to the construction

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[97] Statutes of Quebec. Geo. V, Chap. 148, Article XXXV a & b.

of Place Ville Marie, and brought about many changes in the City's structure, including shift of downtown from the lower town oriented toward the port to the present location much closer to the mountain. This resulted in the intense development of the areas peripheral to the core, especially in the area under study. The City became conscious of the impending dangers to the integrity of Mount Royal as a public park, giving rise to a strong political pressures intent on preserving the mountain as an important public amenity. The City became involved in a direct confrontation with two main forces - a great political power having vested interests in the development of the property representing private sector aspirations; secondly, interests representing the fast-growing city centre, which was developing vertically with its resulting influence on the adjoining areas.

A series of circumstances at this time brought the area in sharp focus and resulted in the evolution of extensive bulk control regulations. These are:

- Intention of the Mount Royal Cemetery Company to sell its surplus land for development in 1960, resulting in a dispute as to the jurisdiction of this land between City of Outremont and Montreal: Freezing of the sale and development by Provincial

Legislation; and final acquisition of the area by City of Montreal, and incorporation in the Park area.

- Construction of Standard Life Building in 1960 and subsequent public protests to save the Mountain.
- Proposal to build high rise apartment towers on the old site of the Montreal Childrens' Hospital, north of Cedar Avenue in 1960: followed by series of protests from the public resulting in acquisition of the site by the City and incorporation in the area of the Park.
- Proposal to construct the Port Royal Apartment building in 1960; resulting struggle in the Court of law and final approval of the scheme based on the Court's decision.
- Proposal to construct Le Cartier Apartment tower under circumstances similar to Port Royal, and final approval of the scheme based on the Court's decision.

Following these events, the political commitment of the City Authorities to fix the legal boundaries of Mount Royal Park which led to a Provincial Act defining the boundaries in 1961

as per Plan No. 247.[98]

- A detailed study of the area by the City Planning Department of the City of Montreal to establish its relationship with the Mountain, resulting in the enactment of Bylaw No. 2812 on February 1, 1963.
- Reconsideration of the area with respect to the development in the last five years between 1963 - 1968, the enactment of Bylaw No. 3722 in September 30, 1968.

The above developments demonstrate the symbolic value of the Mountain to the inhabitants of Montreal, and the keen desire of the City Authorities to preserve its integrity as a major open space, and an important element in the image of the City. This has led to the evolution of various bulk controls and their further revisions over a period of time. Bylaw Nos. 2812 and 3722 have two common objectives:

1. To preserve the view of the Mountain from the south shore as well as to maintain a view of the river from Pine Avenue.
2. Lower density of development to achieve the above.

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[98]Plan of Mount Royal Park showing its boundaries by the Public Works Dept., City of Montreal.

The first bylaw tended to encourage land assembly and tall but slender buildings with certain height limits, whereas the latter bylaw restricts the height and width of buildings, along with the intended creation of a swath between Mountain and Redpath Streets up to Pine Avenue. The failure of Bylaw No. 2812 was attributed to its inability to guide the growth of the area according to the basic concepts of the City Planning Department, i.e. the development of tall and slender buildings with extensive open areas around them. It was also noticed that projected land assembly incentives could be employed against the spirit of the bylaw. Such instances are The Regency apartment building on 3555 Cote des Neiges Road and the Place Elgin apartment building on 1100 McGregor Avenue. In both cases the buildings have taken the form of a slab structure of several storeys height, and spanning the full width of the city block. The Stanley Tower apartment building, however, incorporated the requirements of the bylaw which proved that it is effective in specific circumstances and only needed further refinements. Instead, the City Authorities came up with an entirely different concept in the form of later bylaw which has yet to prove its effectiveness.

Whereas there are clear advantages in preserving major landmarks within a city's structure for better imageability and to provide points of orientation in terms of movement and clarity,

the view from the south shore does not seem to have any relevance in this context. The desire to preserve the Mountain has gone too far in guiding the bulk controls of an important sector in the City. It is only proper that the image of the City should be studied in relation to its internal structure and not based on arbitrary considerations of a distant view.

The value of these objectives to the image of the City cannot be denied, but there is a need for a clearer approach and definition. The reasons for the failure of the first bylaw can be attributed to the lack of vision and guidance. The authorities imposed the bylaw without considering its effects on the direction of growth, land values and aspirations of the property owners. The vision, if at all it existed, was too arbitrary, and the authorities failed to put it across to private interests. The resulting controls directly affected the economics of construction which could be detrimental to the development and growth of the area in the long run. An effective way for the accomplishment of the plan could be through advocacy planning which is proving its effectiveness in urban renewal projects in the United States.

There is an urgent need to have a realistic approach for the bulk controls of the area, which shall not only save the image of the mountain, but also encourage healthy development. It is therefore desirable that:

1. The objectives should be clearly defined and relate to the inner structure of the city. The mountain, as an important element, should primarily contribute to its imageability from within and not based on arbitrary considerations of a distant view.

2. The City Planning Department should come up with a comprehensive Master Plan incorporating their objectives, as well as the interests of the property owners, through periodic consultations with citizens. Such a plan, in the form of a model, or illustrations, can be of immense help in arousing the interest of the general public for its achievement.

3. As envisioned in the earlier bylaw, there is a need for land assembly, to ensure developments with large open spaces around them. These spaces are vital to form a visual link between Sherbrooke Street and the mountain. This can be accomplished through:

   (a) Power of expropriation, through legislation, with the City Authorities to aid in land assembly, by large corporations;

   (b) Development rights transfer, through an amendment in the charter of the City of Montreal.

Whereas the first alternative can present some difficulties, and legal objections from small land holders, the second one can prove more effective. Such transfers are being allowed in high density areas of some cities in the United States (Ref. p. 61). Their provisions act the same way, as land assembly without actually adding land to the development area, and can ensure open area at ground level or low rise buildings creating a general feeling of open space.

4. The maximum building envelope should be consistent with the land use and existing land prices. The provisions of Bylaw No. 3722 restricts the building height in certain areas to 35 feet. With 60% floor coverage, the maximum F. A. R. which could be utilized in three floors only is 1.8. Considering the existing land prices, this is far below the economic justification for development. Such provisions retard incentive to developers resulting in cessation of construction activities.

5. The bylaw states the minimum area of dwelling unit, but there is no requirement of open space related to the population density. An introduction of open space ratio (p. 49) as followed in New York can prove useful.

6. Application of Bonus system in the area to encourage:

(a) Continuous plazas in terrace formation leading from Sherbrooke Street towards the mountain.

(b) Incentive to construct the towers facing north-east and south-west in order to have their shorter side towards the mountain, (Le Cartier apartment building is an example of such development), ensuring sufficient view of the mountain from Sherbrooke Street as well as view of the river from Pine Avenue.

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APPENDIX II

EXTRACT OF THE OFFICIAL BOOK OF REFERENCE
OF THE CITY OF MONTREAL

(West Division) St. Antoine's Ward. 1870.

Block bounded by Cote des Neiges Road, the North West boundary line, the Nos. 1746 1755 and by Redpath and Sherbrooke Streets.

No.	Proprietor's Name.	Frontage. Ft. Inch.		Depth. Ft.Inc.	Area Sq.Ft.
1721	Charles E. Smith	irreg.			13375
1722	Gerhard Lomer	irreg.			40101
1723	John J. Day	irreg.			30102
1724	Alexander Cross	irreg.			515499
1725	David Ross McCord, Annie, Jane & Robert McCord	irreg.			244763
1726	John Hall	irreg.			648877
1727	Alexander Urquhart	irreg.			53346
1728	Catherine Rae	irreg.			20748
1729	David Lewis	151.03 150.00	x	427.00	64317
1730	William Smith	206.00	x	149.06	30849
1731	George Kinlock Starke	207.00	x	149.00	30895
1732	John Foulds	irreg.			31671
1733	John Smith	irreg.			30378
1734	John Rose	irreg.			97900
1735	Henry Thomas	414.00	x	irreg.	122925
1736	Mary Jane Bartlett	irreg.			48004
1737	Benjamin Hutchins	104.00	x	148.00	15496
1738	William H. Benyon	150.00	x	148.00	22200
1739	Catherine Rae	63.06	x	134.00	8509
1740	Edward K. Greene	314.06	x	irreg.	44418
1741	Joseph McKay	29.00	x	140.00	4060
1742	do do	109.06	x	140.00	15339
1743	do do	128.06	x	163.00	20946
1744	Joseph McKay	166.00	x	irreg.	108667

1745	Peter Robertson	351.00	x	163.00	57740
1746	Luther H. Holton	irreg.			94473
1747	John Rankin	300.00	x	152.00	45300
1748	Luther H. Holton	152.00	x	697.00	107512
1749	Grace Shaw	53.06	x	240.03	12847
1750	Ann S. Lowe	53.06	x	240.06	12860
1751	James Hutton	107.00	x	241.00	25760
1752	James Torrance	106.00	x	241.06	25573
1753	Gilbert Scott	99.06	x	321.03	32205
1754	Margaret Kerr	200.06	x	323.00	64611
1755	Jane Drummond, Peter, Mary, Helen, Jane Margaret, John James, Margaret Pringle, George d, Francis Robert, Augusta Eleanor, Emily Jane B. & William Wood Redpath	irreg.			2148755
1756	George Hagar	irreg.			118790
1757	John Dougall	198.00	x	278.06	55143
1758	David Torrance	278.06	x	912.00	253992
1759	William Workman	260.00	x	580.06	149479
1760	Annie McDonald	340.00	x	284.00	96489
1761	James H. Springle	210.06	x	287.00	60308
1762	Hugh McLennon	260.00	x	irreg.	78472
1763	Robert Campbell	irreg.			229960
1764	Pierre Guyon dit Lemoine	irreg.			447902
1765	William M. Molson	232.06	x	318.00	75128
1766	Theodore Hart	512.00	x	318.00	161544
1767	William Muir	120.00	x	318.09	38235
1768	Alphonse Leclaire	121.00	x	319.00	38584
1769	Thomas Ryan	120.00	x	145.00	17400
1770	John Fairbairn	irreg.			19332
1771	John Frothingham	120.00	x	290.00	34800
1772	Hannah Lyman	120.00	x	145.00	17400
1773	Jonathan Hodgson	120.00	x	145.00	17400
1774	Duncan McIntyre	120.00	x	145.00	17400
1775	George Kinlock Starke	120.00	x	145.00	17400
1776	John Hamilton	145.00	x	170.00	24650
1777	Elizabeth Fisher Lochart	145.00	x	170	24650
1778	Edward M. Hopkins	192.00	x	153.04	29408
1779	Nichol Finlayson, John, Ann Cameron & Rodrick Finlayson, Ann McKenzie & Jessie Reid Finlayson, Kenneth & Hector McKenzie	96.00	x	153.06	14728

1780	Romeo H. Stephens	26.00	x	130.00	3380
1781	John Elliott	26.00	x	130.00	3380
1782	George Thompson	26.00	x	130.00	3380
1783	Mary Ann Campbell	26.00	x	130.00	3380
1784	Jonathan Hodgson	26.00	x	130.00	3380
1785	Alexander McKenzie Forbes	26.00	x	130.00	3380
1786	Jackson Rae	26.00	x	130.00	3380
1787	George S. Scott	26.00	x	130.00	3380
1788	Samuel H. & Alex S. Ewing	84.00	x	134.00	11256
1789	Thomas W. Ritchie	26.00	x	134.00	3484
1790	Arthur Fisher	26.00	x	134.00	3484
1791	Thomas Ogilvie	26.00	x	134.00	3484
1792	Andrew, John & Grace Ewart	26.00	x	134.00	3484
1793	Richard Wolff	26.00	x	134.00	3484
1794	David Torrance	341.00	x	284.00	96560
1795	Alfred Savage	301.00	x	143.06	43194
1796	Andrew Allan	302.00	x	144.06	43639
1797	do do	irreg.			130602
1798	Matthew H. Gault	301.00	x	144.06	43495
1799	Mary Katen	irreg.			25665
1800	Hugh Allan	irreg.			609108

APPENDIX III:

Bylaw No. 1900.
November 4, 1948.

Chapter 3.

Maximum Volume: - Cubic Footage not to exceed 130 times the area of lot.

Maximum Area; (F.A.R.)

12.00

Except Department Stores:

8.00 maximum (lot fronting on 3 streets)

7.00 maximum (lot fronting on 2 streets)

5.00 maximum (lot fronting on 1 street)

Maximum Height:

Street Side:

- Vertical line erected at street line continued by straight line inclined towards the interior in proportion of 4 vertical to 1 horizontal.
- Height of vertical line - twice the width of street without exceeding 130'-0".

Rear Side:

- Same as for Street Side.

Towers:

Towers allowed if building frontage is:

a) 30% of total frontage of lot for street. 50 feet wide or less.

b) 40% for streets more than 50 feet wide.

c) 50% for lots abutting on two streets.

d) 60% for lots opposite a park or square.

Rear setback = 25 feet minimum.

Coverage: Res. 75% on interior lot.

90% on corner lots.

Com: 100%.

Courts: Outer Court:

6'-6" plus 2'-0" for each storey in excess of 2. Width increased by 1'-0" for every 10 feet of court length.

Through Court:

Minimum 6'-6" plus 2'-0" for each storey above 2.

Inner Court:

Minimum width of 12'-0" plus 2'-0" for each storey above 2.