HOUSING IN URBAN PLANNING

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This is a translated abstract of the study "Housing in Urban Planning", which includes the contents, four resumes, the synthesis and a large number of diagrams. Its purpose is to help American readers in understanding the concepts, methods and techniques in discussion with the author.

Considering the theoretical character and general meaning of this study, it might be feasible later to translate the entire study.

I am very thankful to Mr. Chapin Cook and Miss Susan Battersby for editorial assistance.

Mike Kojovic

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Introduction

The study "Housing in Urban Planning" was done for the City-Town Planning Institute Section of the Permanent Conference of Yugoslav Cities. It was done in the period from May 1969 to July 1970, something shorter than was planned. It was made possible by previous authors' works which represented a continual research activity in urban planning and particularly in housing planning.

We suggest that this study solves a larger part of the theoretical problems of housing planning which have not been solved adequately or which have not been posed as problems. Of course, there is a lot of research work going on, but it will be easier, more definite and probaly more qualitative than this study.

There were several reasons for this research project. The importance of urban planning for the realization of preconditions of housing building becomes very actual. Solving of housing problems becomes more and more complex a task. Meanwhile, present housing theory as well as urban practice and legislation do not give all the necessary elements for making qualitative urban plans and housing programs from the point of view of analysis which should proceed design and components of planning and programming. Housing, although one of the most important components of urban planning, has not been particularly explored in a comprehensive sense more than partially, with a predominant technic or economic approach. As a consequence, we have suitably examined influences and correlations of technical, economic and sociological factors. Hence, the solving of housing problems in urban planning is made considerably heavy and retarded.

The basic aim of this study is the advancement of urban planning methodology in the housing aspects, and the purpose is to contribute to the establishing of a general theory of city development planning. Besides such a general thesis, there are some manpower aspects which are important in three aspects: theory, practice and legislation.

As the first task we pose the defining of elements which make possible addition and correction of present laws and rules in the urban planning domain, concerning subjects and methods of urban plans and programs.

The second general task is related to methods of system-analysis of housing, as rounded and complex urban planning theory, operating by technical, economical and social factors. Research complexity is expressed by the width of observing field hold: metropolis, city and settlement.

As the third task we pose the establishing of analytic quantification methods of housing needs on the city, metropolis and national levels, including its practical application in a certain measure. In this case, Belgrade and the Federation were taken as the observation field, but more in the sense of proposed methods testing than because of concrete solving of present problems.

The fourth task was the establishing of analytic methods of housing planning and programming in new settlements and residential zones of a city, including defining of criteria and optimalization methods.

The fifth task was the establishment of planning methods on metropolis and city levels.

The sixth task was establishing analytic methods for investigation of conditions and the possibility of housing reconstruction in a city.

As a consequence of such tasks, we had another factor of general importance: the mathematical base due to computer technics application (system of mathematical models). We also supposed that this investigation will open new routes for other research, wider, deeper, and more complex. We hope that a large part of the above mentioned tasks are solved, although we are aware that the possibilities of such individual research are limited and results would be better if experts of other disciplines, such as economists, mathematicians, communal engineers, ecologists, etc. were included. Regardless, we hope that in further research the collaboration in a multidisciplinary team may be more successful.

In a methodological sense this job was predominantly theoretical, in less measure empiric, considering that certain phenomenons, models and analysis were applied to concrete situations. Concrete and real data, such as technical, statistical and others were used.

As a phenomenon, housing has been observed in the context of an urbanization and metropolitanization process from the point of view of time dynamically and from the point of view of space in micro and macro extents. As a function, housing has been observed as the basic function, complemented by a number of other functions, changeable after contents and importance, depending on space level. Settlement, region, zone, and city represent space units of observation in the integral urban system.

Research subjects were establishing, investigation and measure of phenomenons and processes, as well as establishing relations and correlations expressed by mathematical language as models. By that, statistical and mathematical analytic methods were used.

Future research should be oriented in three directions: 1) testing, 2) methodology, 3) computer programming.

In the first case given mathematical models should be tested, corrected and completed, in order to establish its life values.

In the second case, planning methodology should be perfected further, parameters to be callibrated, values of present criteria, normatives and standards to be tested and completed, as well as the list of mathematical models.

In the third case, the linkage of mathematical models expressing the planning process should be treated as software so that the planning process would be a partial or fully automatic process.

This study has five parts. The first part implies methods of analysis of housing needs in the city; the second implies investigation of housing development in the metropolis and city; the third implies methods of housing planning in a metropolis; and the fourth implies methods of housing planning in a city. The fifth part is composed of the synthesis and conclusions.

1st Part: QUANTITATIVE ANALYSIS METHODS OF HOUSING NEEDS IN A CITY - RESUME

Urban development of a city should be investigated as a dynamic process, changeable in space and time. This process can be followed, measured and foreseen using statistical data and mathematical methods. Housing needs are the concrete result and consequence of an urbanization process. These phenomena of urbanization should be investigated in order for housing needs to be estimated. Phenomena of urbanization and housing needs of Belgrade, as an example, were investigated in order to propose quantification methods to be tested and examined. It is very important to define the meaning of housing, housing needs and the observation field. Here, housing is understood in the wider sense as a complex function which should be considered interdependently with other functions, because it considerably influences other activities such as the economy. Housing needs should be observed in three areas: as a shortage, as quantitative demands, and as qualitative demands, concerning different levels of economic, social and technical development. Such housing definitions as well as the desirable policy of housing solutions have particular importance for the secular urban development. In this connection, urban territory may be divided into four areas, but but the investigation of housing needs should enclose at least two: the city (central city and inner city) and the metropolitan area.

The analysis of potential housing needs should be based on the established trends of population and housing stock. The first function should be total population and total household units growth. The second function should be the total number of housing units. Applicable methods are interpolation and extrapolation which need observation for relatively long periods, at least ten years, as well as data for at least three points in time.

Investigation of the basic functions (population and housing stock) for Belgrade implyed a parabolic function of the second degree, so linear differential functions were produced, implying yearly changes. If computer techniques were used, it would be able to operate with functions of a higher degree (implying the methods of square approximation). Analysis of the population and housing stock functions for Belgrade indicated a specific situation of a large city -- slum phenomenon is tolerated if a housing shortage exists, as well as very rapid growth of housing stock, which will probably decline if the housing shortage is eliminated.

Using basic differential functions (with yearly changes) of household and housing stock (apartments), the quantitative demands can be estimated by the integral equation, remembering the circumstances in the defined point of observation.

The concrete investigation of housing needs in Belgrade indicates the housing shortage might be eliminated during the 1971-76 period. After that, solving of quantitative demands must be maintained, and the elimination of undesirable apartments and slums becomes important. The definition of this period should be subject to the urban policy, and the decision-making should be based on expressed tendencies. In the case of Belgrade it may mean the quantitative housing demand would be satisfied perhaps by 1980. The solution of the qualitative housing demands means to approach city renewal, rehabilitation, and changing of the present urban structure. Such problems should be solved in a comprehensive way, closely related with traffic problems.

Investigation of housing conditions and possibilities for renewal should imply the global investigation of housing situations for the whole city and differentially for the observational units (block and neighborhood units). The analysis of urban renewal conditions should operate within the priority of particular renewal projects, keeping in mind urban development on the whole as well as criteria and standards related to the minimum degree of toleration.

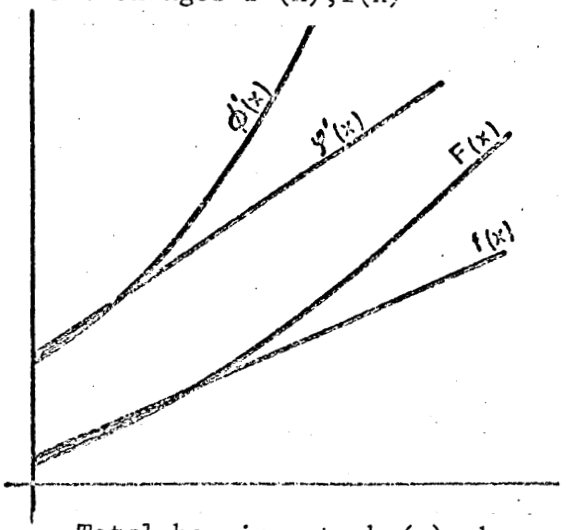
Investigation of the concrete housing situation of Belgrade has indicated a cyclical character of the urbanization process; that is, relatively regular exchanges of growing housing demand and its elimination. Such a function has an irregular sinus shape, and it may be used with certain corrections in concrete planning. Considering the next two cycles, at least, can be foreseen after the housing shortage elimination cycle. These cycles represent the qualitative housing demand cycle as well as the post qualitative cycle. This latter may mean the phenomenon of a new and specific housing need created by the advanced technology, material and cultural progress. The following cycles mean the satisfying of the needs of the previous periods.

Establishment of the cyclical character of the urbanization process may have a particular importance for city planning because it may make possible long-range programs; not only in the housing point of view, but perhaps urban development on the whole. The example of Belgrade indicates declining of the

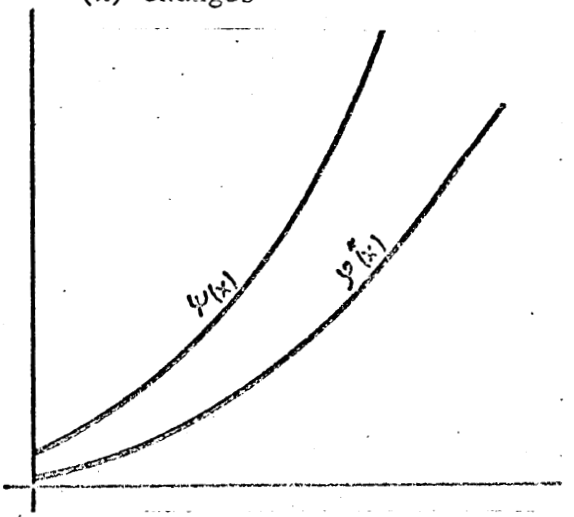
periodicity of cyclical urban development. Such irregular periods of the urbanization process indicates that the planning process should be periodically adjusted. There would be a great difference, comparing the mechanically defined periods of master city plans (of 20 to 30 years) with those of today.

USED IN HOUSING NEED ANALYSIS

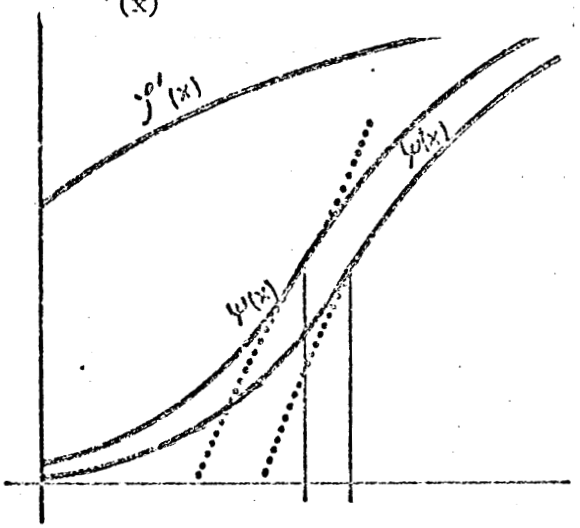
Population growth F'(x) and household growth F(x) and its changes f'(x), f(x)



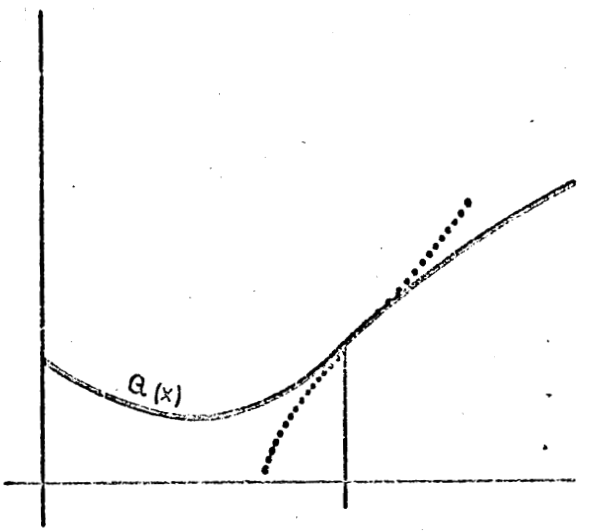
Total housing stock (x) and standard housing stock (x) changes



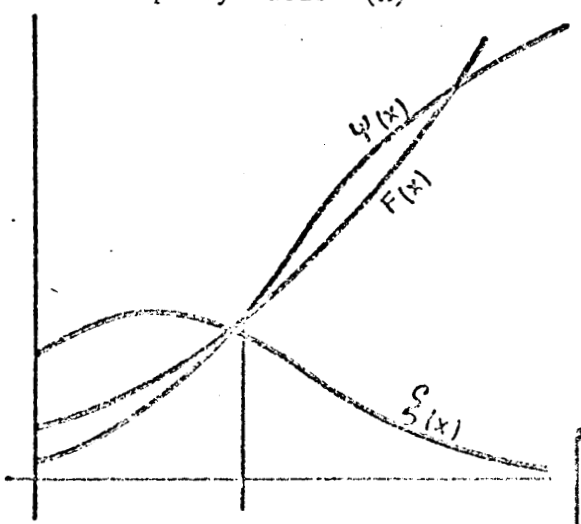
Total housing stock (x) changes, hygienic satisfying stock '(x) and its relative changes '(x)



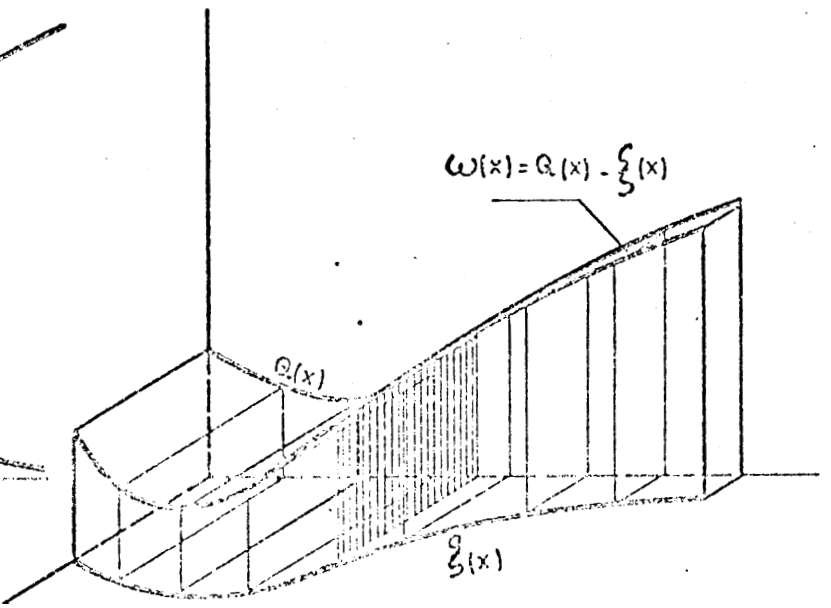
Nonhygienic housing stock changes Q(x)

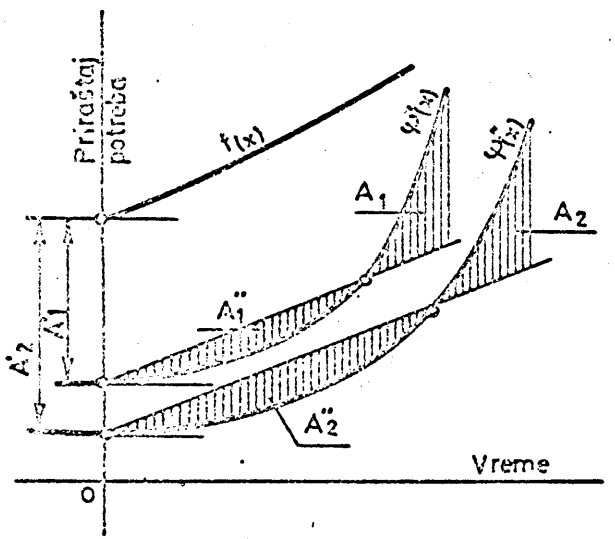


Household growth F(x) housing stock growth (x) and flat occupancy ratio (x)



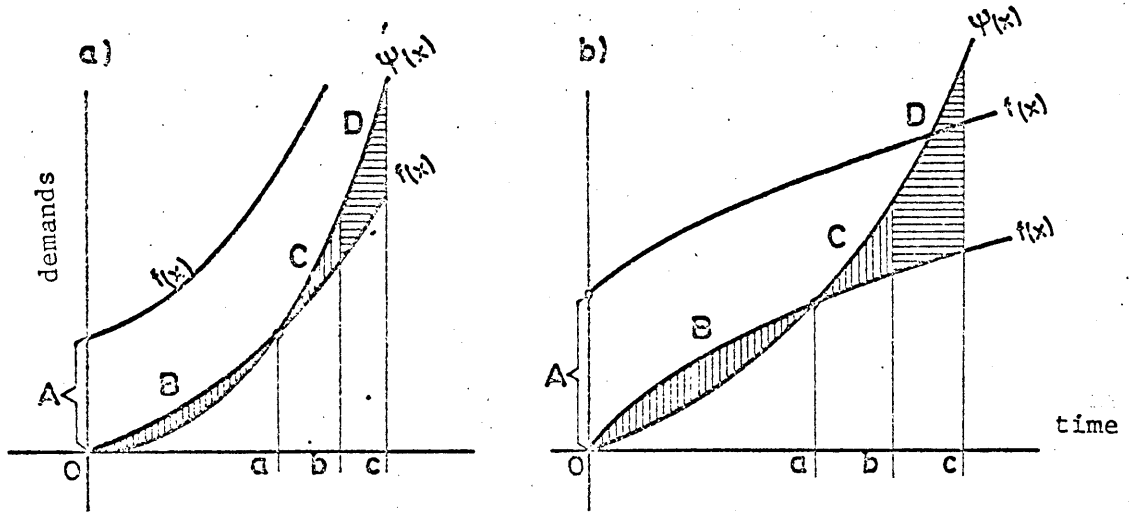
Population growth in nonhygienic housing stock



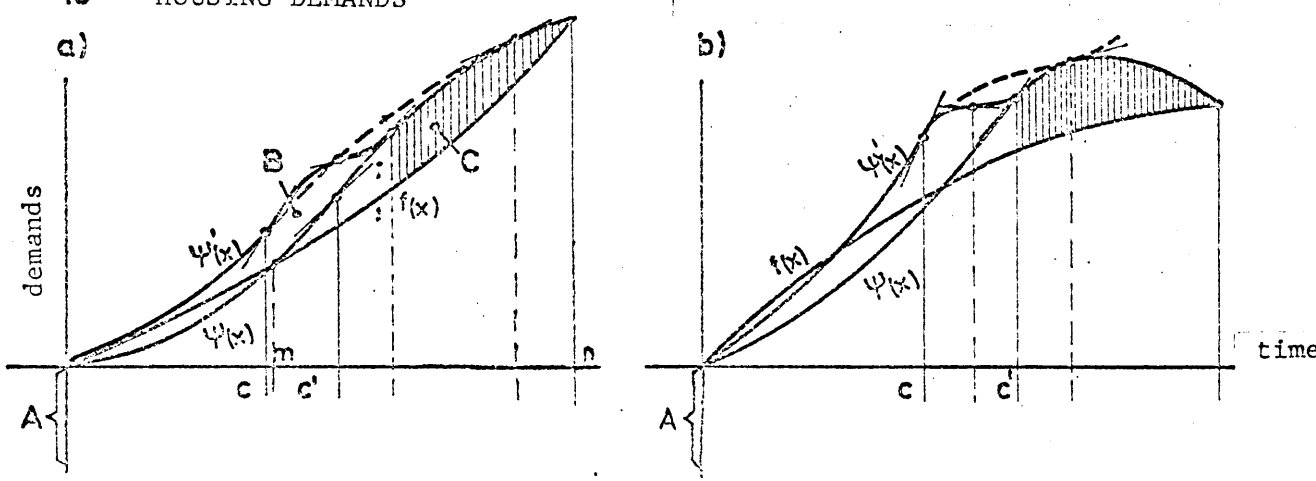


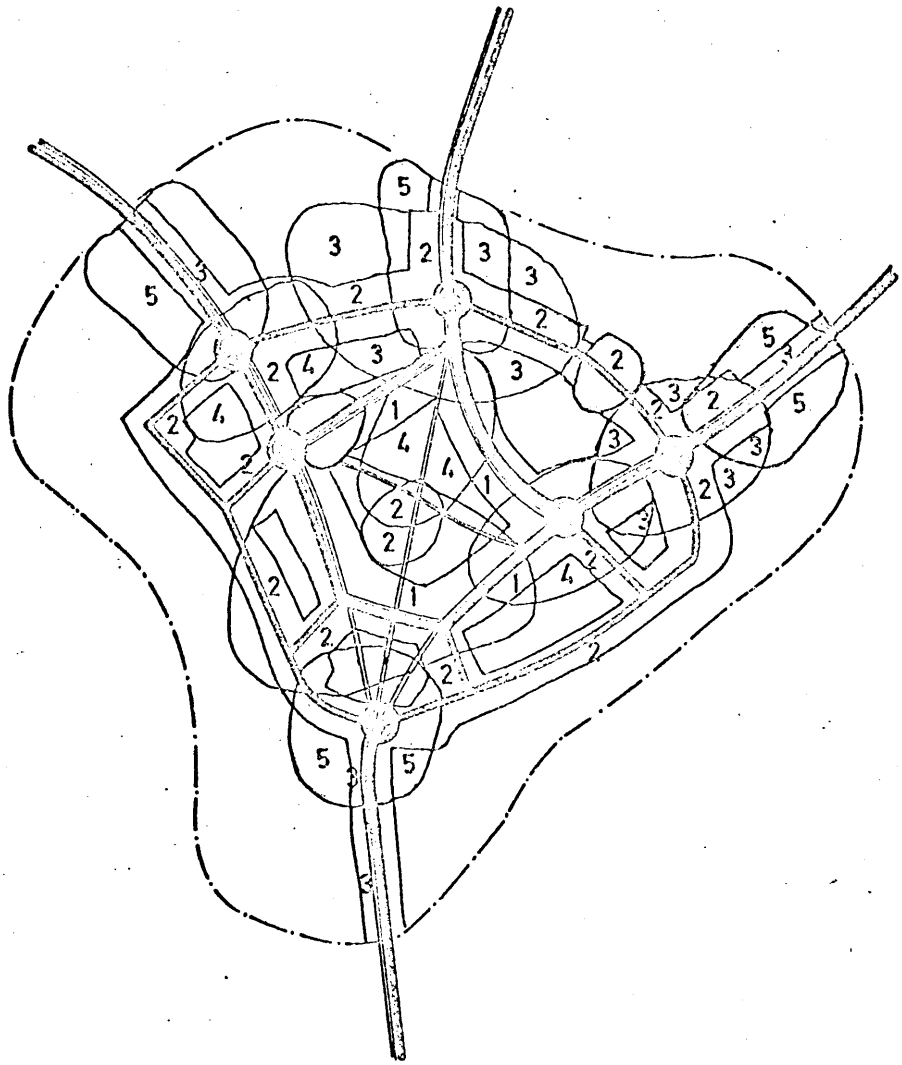
7 GEOMETRIC MEANING OF QUANTITATIVE HOUSING NEEDS

9 PERIODS OF HOUSING SHORTAGE EXTENDING AND ELIMINATION



10 SOLVING PERIODS OF QUALITATIVE HOUSING DEMANDS





1- Primary sectors - traffic reconstruction belts

2- Nonhygienic housing stock

3- Amortized HS

4- Deteriorated non-amort.HS

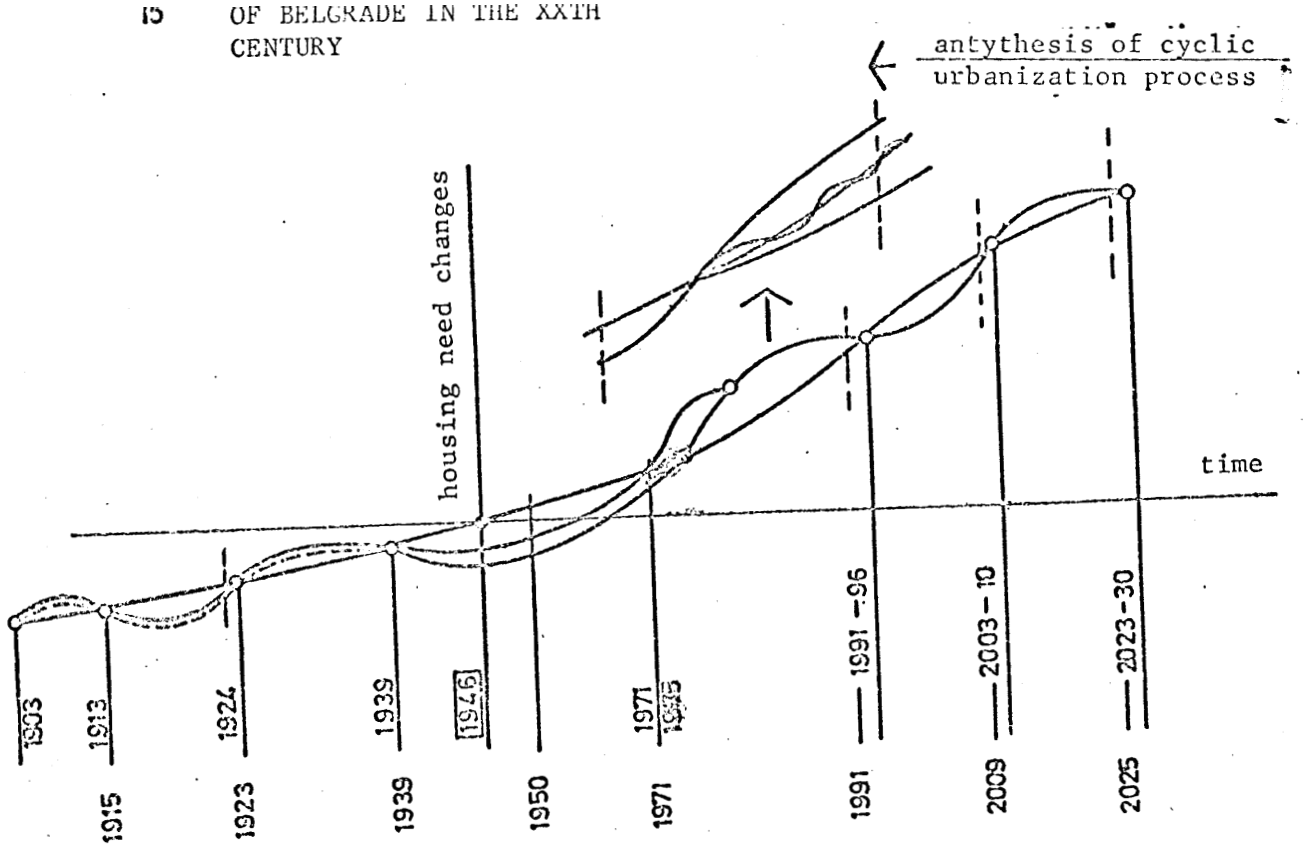
5- Urban non-satisfying HS

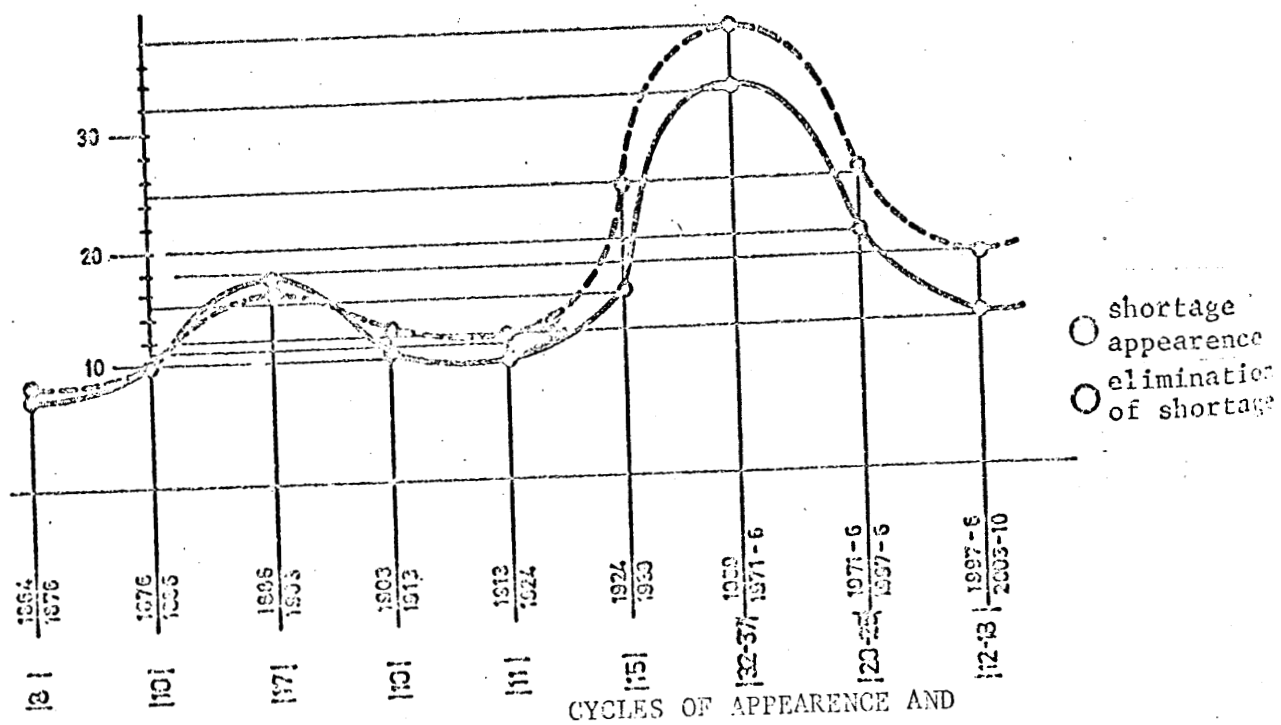
6- Reconstruction bounderies

7- City area boundaries

8- Present traffic lines

15 OF BELGRADE IN THE XXTH CENTURY





CYCLES OF APPEARENCE AND ELIMINATION OF HOUSING SHORTAGES IN BELGRADE IN THE XXTH CENTURY

2nd Part: INVESTIGATION METHODS OF HOUSING DEVELOPMENT PROCESS - RESUME

Housing development process should be investigated in the context of the urbanization process in a metropolis, in a quantitative and a qualitative sense. Such an investigation implys previously defined quantification methods - the measuring of this process.

The method is based on the real fact that a metropolis has influence in its wider area, more or less urbanized. This regional influence of the metropolis declines in the distance function. Through time, this influence changes itself according to the defined statistical rule. The entity of the housing development process may be expressed by the correlation of more determinants, which define housing demands and direct their solution in a quantitative and qualitative sense. Influential factors should be classified as exogenous - external determinants which define housing demands in the economic-social aspect; as endogenous - internally determined physical and technical structures; and finally as exogenous-endogenous factors, which express the way of satisfying housing demands in the social aspect.

The method represents mathematical interpretation of the single or multi-correlations of housing determinants. The single correlation implys partially established dependence of the exogenous or the endogenous factors and space, and in such a way, changes of superimposed metropolitan influences in the regional area. The observation method is twofold, quantitative and qualitative. In the first case the distribution of housing determinants should be observed in the space, implying regression analysis. The distribution law may be established by the coefficient of correlation. This case implys defining the declination of given standard values of housing determinants, according to the well-known methods of statistics. In both cases, the establishment of the correlation of housing determinants and space is based in the specific area division by concentric circles with regular radiuses, as well as by sectors, according to important directions of historical city development.

On the basis of the previously established statistic law of housing determinant distribution in space and the declination from the standard values, it is possible to establish the investigation method of multi-correlation of exogenous and endogenous factors related to basic and non-basic housing determinants.

This method operates with two indicators: first, the agreement of housing determinants which should be used as a measure of declination of the basic from the non-basic housing determinants, and second, the deviation degree of housing determinants which should be used as the declination values of housing determinants related to standard values.

During the realization of city urban plans, housing problems should be followed as a developing process. Results of such following can provide real additions and corrections of existing city plans. The subject of such following should be quantification of the housing development process based on several indicators such as building density, residential density, residential surface for habitant, as well as the correlation between residential surface and personal income (per capita), and the relation between building density income and residential density. These correlations should be observed in time series or in time function. In this way it would be possible to establish stochastic rules of changes with the higher or lower coefficient correlation, depending on the chosen regression to which the observed process approximates. On the basis of so-established trends, housing development process can be followed in the past period as well as foreseen in the future.

Following of the housing urban standards should be put as the first task of housing investigation. In this case, the urban standard may be generally expressed by building density and residential density. Observing the relation of housing process and planning circumstances, it would be possible to estimate the reality of the planning, and according to that, to correct the process function in the future.

Following of urbo-structural changes should be put as the second task of housing investigation in a city. It implys the relation between the total housing surface and the average floor number of houses.

Both relations - urban standard of housing and urban structure of housing - can be brought in the mutual connection, getting the multi-correlations of space structures. Hence on this basis housing process can be followed and estimated in the whole.

Investigation of housing urban values implys analytical estimation of urban natural indicators. The purpose of such an investigation should be establishing of urban planning values of settlement from the point of view of land use and space

occupancy. The method implys the correlation of factors, reflecting two dimensions (distribution of settlement surface) and three dimensions (space structures of housing). The participation of open surfaces related to the total settlement area is expressed by three independent variables: building ratio, residential area ratio (related to the total area), and average number of floors. Building ratio may be expressed by the production of residential density and standard housing surface. This correlation indicates the open surface growths, if the open surface and the number of floors increase, for the constant building ratio. Conversely, if these values are constant, building ratio should be declined in order to get more open surface. These values, meanwhile, should be standard ones. It means if the housing surface is standard then the number of floors should be definite according to different residential densities, so the standard open surface will be satisfied. Therefore, the reserved number of floors doesn't mean the fixing of the space residential structure in a settlement, but a level (average) on which the floor structure of houses may be changed in the defined boundaries.

The aim of such investigation is to test the correctness of parameters in the designing process or later. The method may also be used in more detailed planning of settlement urban structures. Generally speaking, the purpose of such investigation is to exclude indefinitness in the planning of space structures.

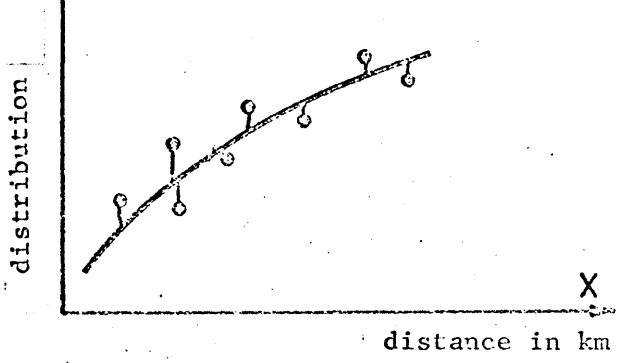
Cost examination of settlements which will be built or which are built implys three different tasks according to its character and goals. Every one of them needs the application of quantification methods of statistic mathematics and has the purpose of establishing objectivity and reality of planning solutions.

The first task represents the establishment of the range of settlement building costs according to the found or determined dependence between housing surface unit cost (per unit of housing surface) and building density, as well as the magnitude of settlement (territory surface). On the basis of the correlation coefficient, the degree of dependence between cost and building density and settlement magnitude may be established. The range may be done according to the partial settlement cost deviations related to the average regression.

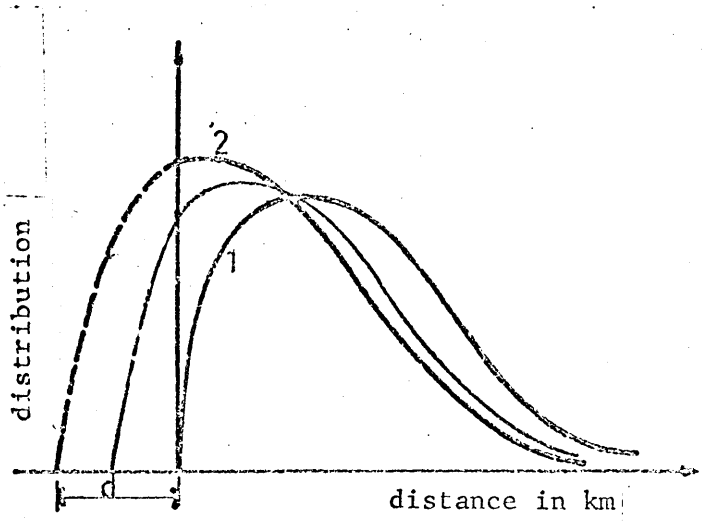
The second task is the establishment of the cost threshold of the optimal influence of building density and settlement magnitude. On the basis of the twofold correlation: cost and building

density, cost and settlement magnitude, it is possible to establish the optimal field (optimal polygon) in order to establish the dispersion related to the optimal polygon. It implys usage of the direction coefficient of the regressions and establishment of the polygon according to the settlement building cost data. The dispersion rate is expressed as the square root of the quotient of the optimal surface (polygon) and partial cost polygons.

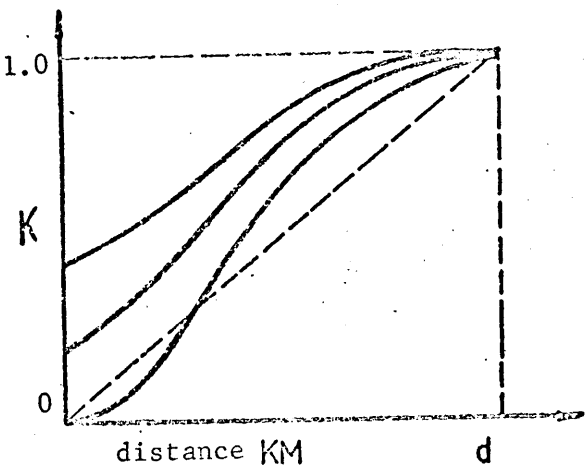
The third task implys the establishing of the optimal building cost of settlements. This task may be solved on the basis of previously established optimal values of building density and settlement magnitude. These values should be put in the regression of total building cost (1st task). The cost losses would be accounted on the basis of optimal unit cost, respectively the total optimal cost divided by the total residential surface.



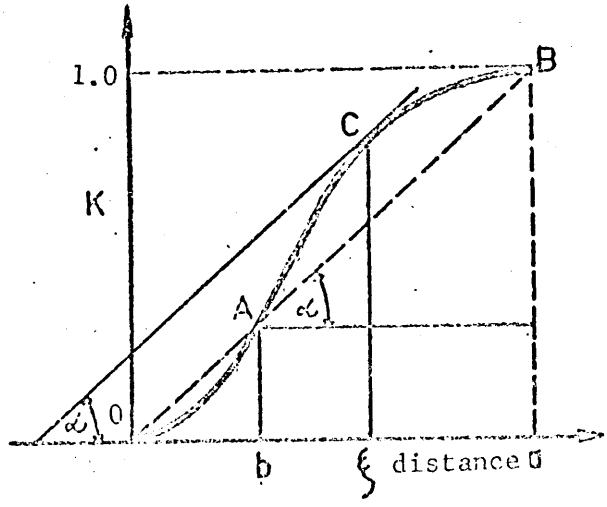
PRINCIPLE DIAGRAM OF HOUSING DETERMINANTS DISTRIBUTION IN THE SPACE



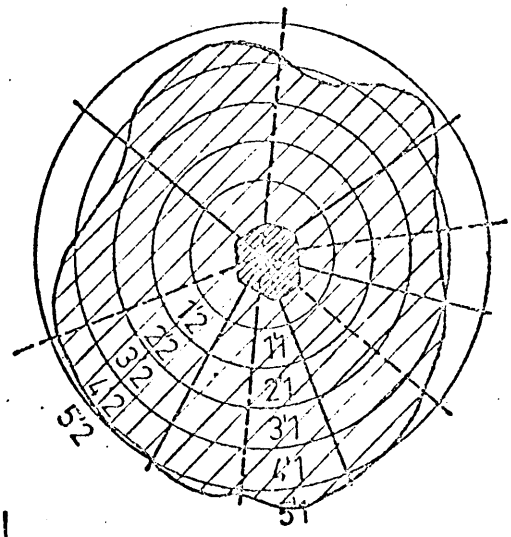
PROBABLE HOUSING DETERMINANTS DISTRIBUTION IN THE SPACE - EXTREMES



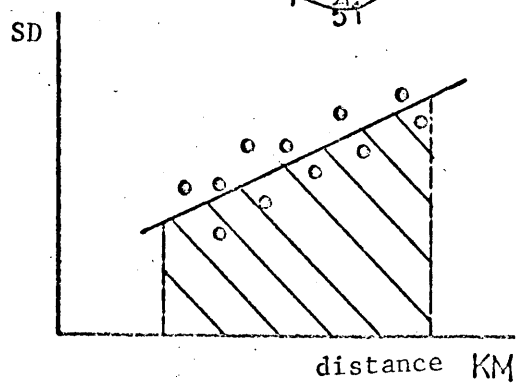
PROBABLE CUMULATIVE FUNCTIONS OF HOUSING DETRMINANTS DISTRIBUTION IN THE SPACE



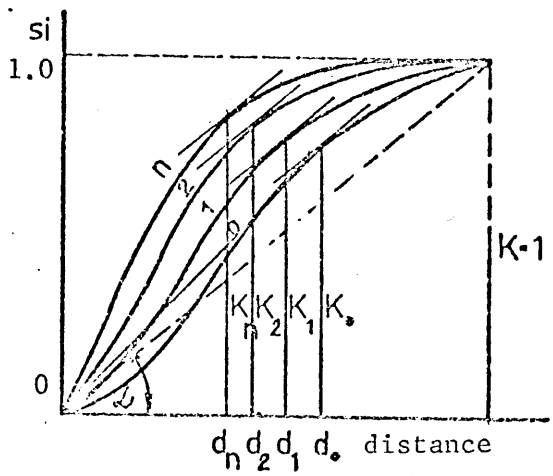
GEOMETRIC MEANING OF BOUNDERY DEFINING OF THE HOMOGENOUS HOUSING DETERMINANTS DISTRIBUTION



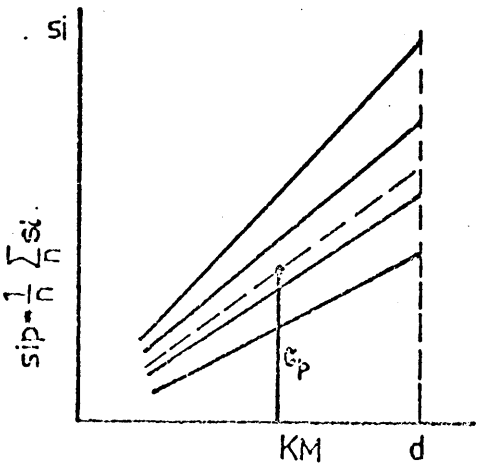
DEVISION SCHEME OF THE OBSERVED AREA, ACCORDING TO RINGS AND SECTORS



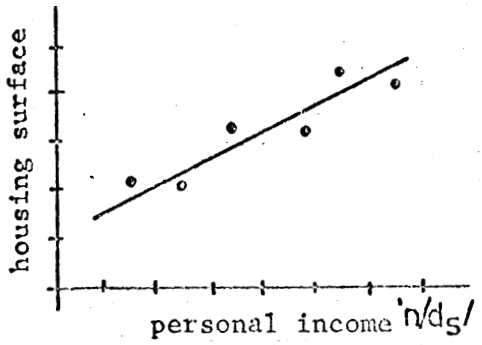
CORRELATION OF STANDARD HOUSING DETERMINANTS DEVIATION AND DISTANCE



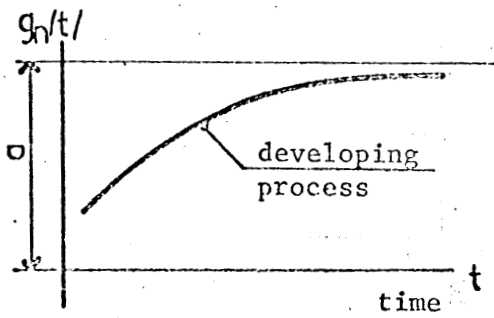
GEOMETRIC MEANING OF THE HOUSING DETERMINANTS AGREEMMENT DEGREE (HDAD)



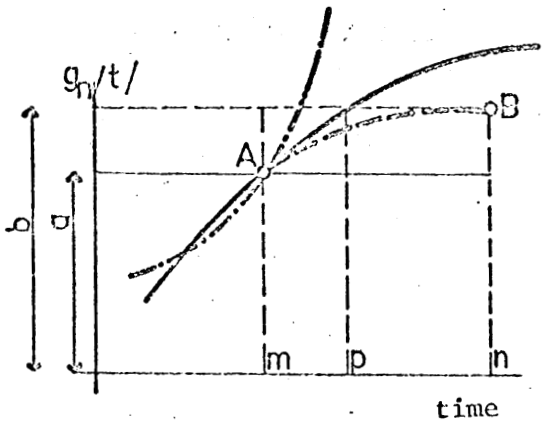
GEOMETRIC MEANING OF THE HOUSING DETERMINANTS DEVIATION DEGREE



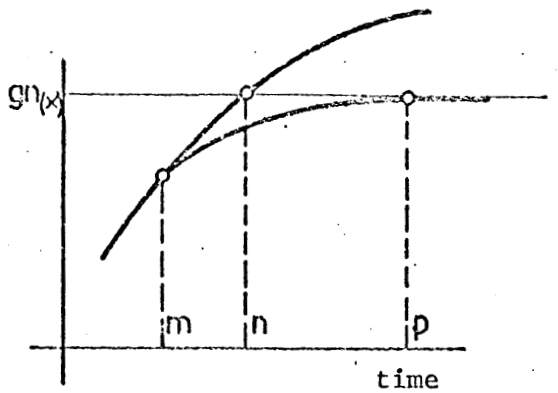
CORRELATION OF HOUSING SURFACE AND PERSONAL INCOME



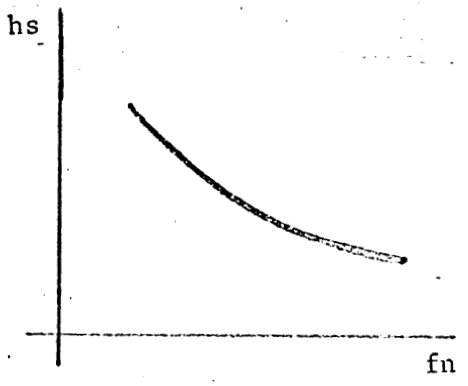
DEVELOPING HOUSING PROCESS



PENETRATING TENDENCES OF THE URBAN STANDARD LEVEL

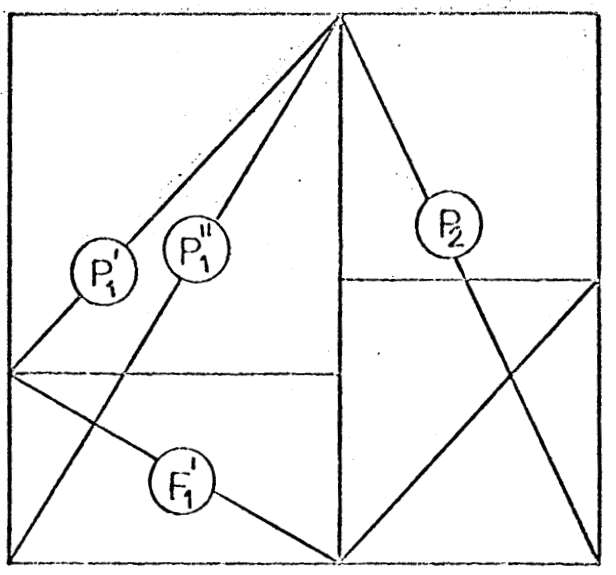


ALTERNATIVE HOUSING PROCESS

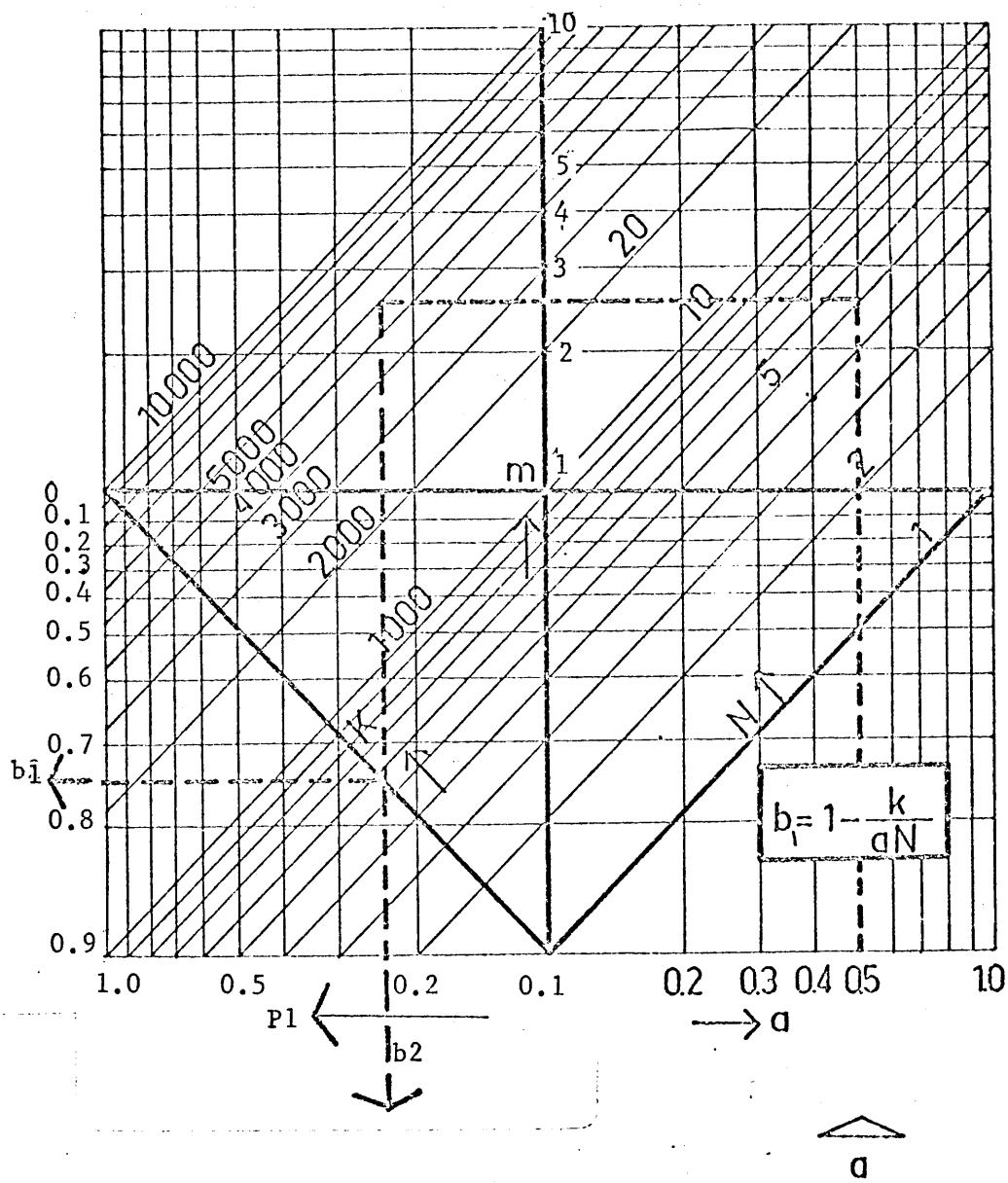


CORRELATION OF HOUSING SURFACE (hs) and AVERAGE FLOOR NUMBER (fn)

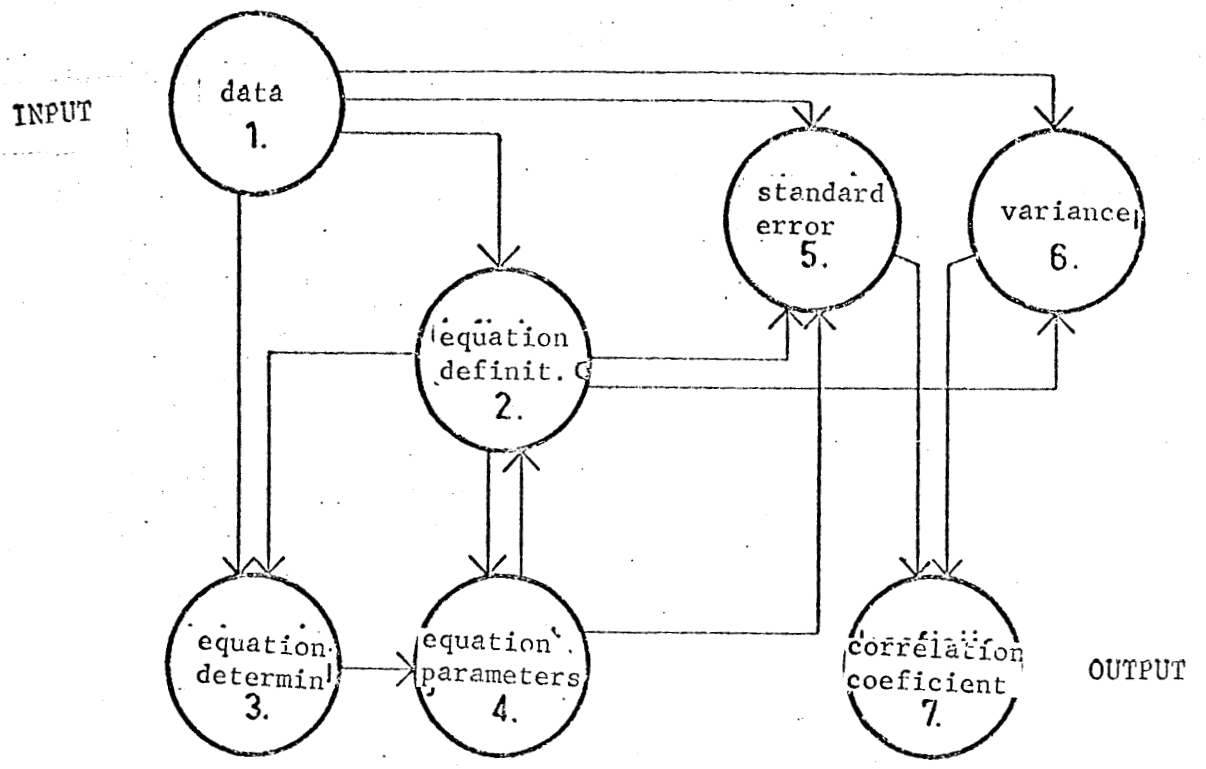
SETTLEMENT AREA DISTRIBUTION SCHEME OF RESIDENTIAL (P1) AND NONRESIDENTIAL (P2) PARTS



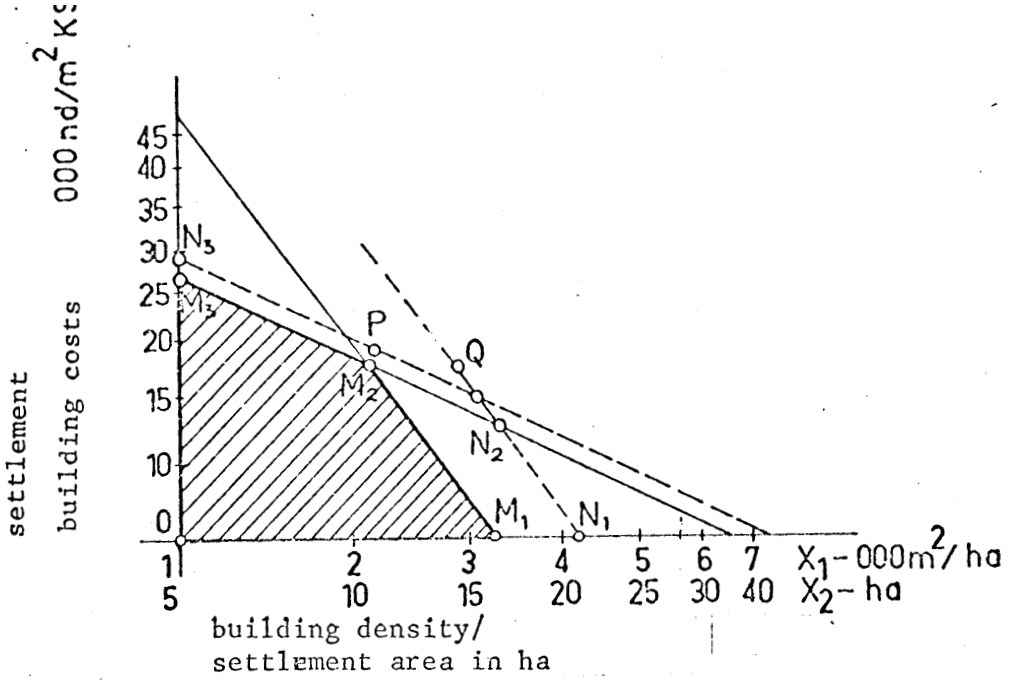
15 NOMOGRAM OF THE EQUATION OF THE OPEN AREA DISTRIBUTION IN RESIDENTIAL PART OF A SETTLEMENT



P1 - residential area of settlement
a1 - residential area ratio (in total area)
b1 - open area ratio (in total area)
b2 - built area ratio (in total residential area)
N - average floor number
K - gross building coeficient

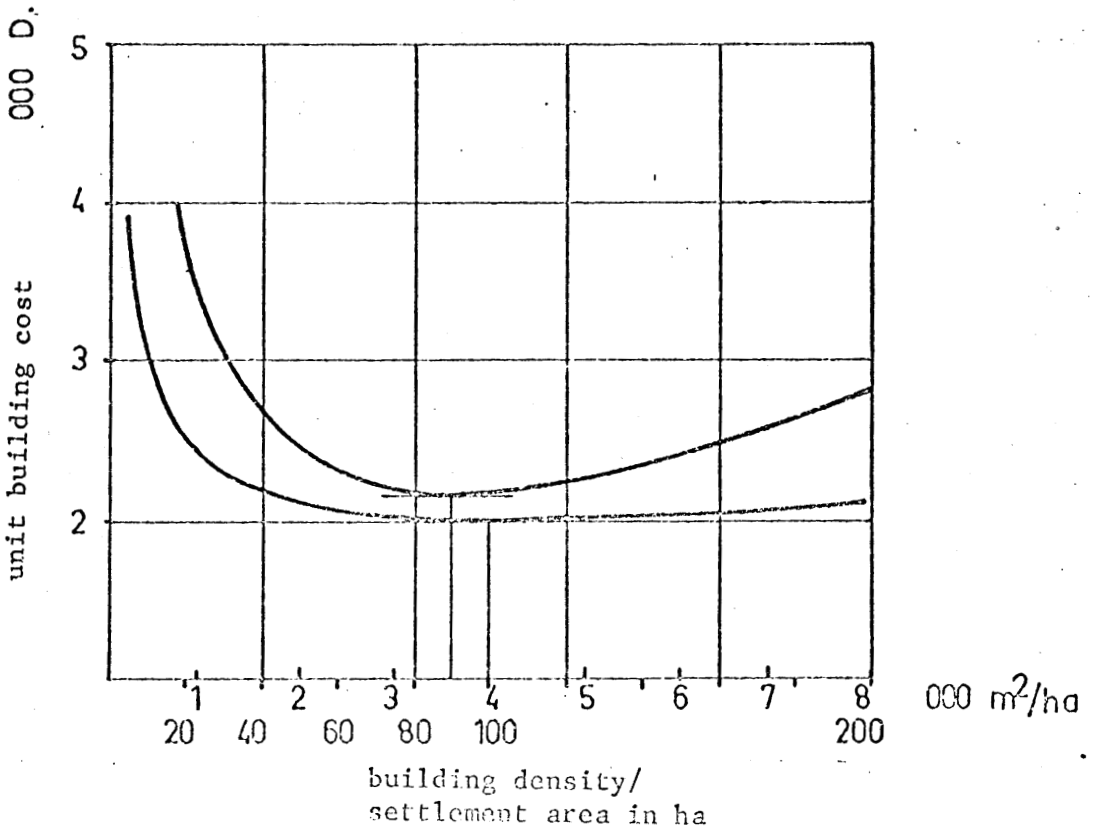


16 SCHEME OF THE ACCOUNT PROCEDURE
OF THE REAGRESSION ANALYSIS



17 THE SCOPE OF THE OPTIMAL INFLUNCS OF BUILDING DENSITY AND TERRITORY MAGNITUDE ON THE UNIT COSTS

17' UNIT BUILDING COSTS OF SETTLEMENT DEPENDING ON BUILDING DENSITY AND TERRITORY MAGNITUDE



3rd Part: METHODS OF HOUSING PLANNING IN A METROPOLIS - RESUME

Today, housing as a function should be solved in a comprehensive way linked with other functions such as supplying, education, work, recreation and traffic because their mutual connections are becomming closer. In this way, housing becomes more qualitative, but planning techniques become more complex because of more complicated problems which appear. These considerations of comprehensive planning belong to the general planning phase.

The comprehensive plan should be used as a reliable implement for definite urban development guidance. It should provide: rational usage of resources; land, water and air protection; rational working and living organization; and proportionality and equality of living conditions. The comprehensive plan should be a physical expression of a thinking planning process, implying a continual action flow. The planning process should consist of five fields of activities: 1) definition of wishes and goals, 2) projection of wishes and goals, 3) deduction and forecasting, 4) choice of alternatives, and 5) implementation. Science, experience and innovation should find their place in all of these fields in their feedback.

The subject of comprehensive planning can be generally expressed by the extent of these activities: 1) formulation of metropolitan development goals, 2) preparation and operation of intersectorial long-range plans (20-40 years), 3) permanent investigation of metropolitan development proposals, and 4) permanent investigation of comprehensive developing plans in particular sectors. Hence, planning process implys the row of particular actions whose purposes should provide comprehensiveness and coordination, in space and time, between particular sectors.

More effective planning in 70th years should consist of six technical imperatives: 1) specification of proper sphere of actions, 2) projection of the prototype of planning process, 3) construction of metropolitan development scheme, 4) new planning techniques, 5) definition of the basic year (1971), and 6) application of an operating program and realizing control.

The structure of a comprehensive plan should be composed of four steps: 1) long-range plan (30-40 years), 2) developing plan (10-15 years), 3) developing program (3-5 years), 4) budget plan (1 year).

The general plan should be: 1) in the focus of physical development, 2) long range, 3) comprehensive, 4) general, 5) clear performance of basic policies.

In the context of complex and very responsible tasks of comprehensive urban development enclosing all infra and superstructures (physical ones), as well as social-economic activities, housing has a very important place from the point of view of planning of new capacities and rehabilitation of present non-contemporary and non-adequate human abode in a city.

Sectoral housing analysis should surround three investigating subjects: structure, distribution and synthesis. In the first case, changes (in a dynamical sense) for city and metropolis should be investigated in order for tendencies and trends to be established for particular phenomena which have a predominantly economic and social character. In the second case, space distribution of physical structures should be investigated, and this analysis should be different and distinguished from the first global one. Finally, accomplished investigations should be synthesized in the space aspect, as well as the time development aspect, with the purpose of future development forecasting. Structure analysis surrounds: 1) housing shortage, 2) quantitative and qualitative (potential) housing demands, 3) housing standards from the point of view of needed surfaces and housing types (one family or multi-family houses). Distribution analysis should surround: 1) population, income and employment; 2) apartments and houses; and 3) land.

Comprehensive housing planning in a city, because of complex quantitative and qualitative tasks, demands investigation of changes in a metropolitan area. The aim of such investigation should be the forecasting of changes and trends in the future. On this base, actions for housing problem-solving would be planned and undertaken. The success of forecasting depends on the character of moving through time, its continuity, or its discontinuity. In the former case, forecasting is easier and more confident. But in the latter case, movings which represent accidential processes (named Markovian) can be foreseen in a certain sense. Regardless, we need to know the process and we have to follow it through for a relatively long time period in order for the process to be expressed and operated in a mathematical way.

There are two different groups of elements of macro and micro character. The first one implys urban growth, population

and physical structure whose changes have long-range character and far-reaching importance. The second one implys behavioral phenomena, communication and other social manifestations. This group differs according to the degree of freedom and periodicity of changes. Respectively they have a different cycle of development, and because of that it would be particularly observed and forecasted, having in mind many external influences.

In the housing planning aspect, it is particularly important to foresee urban development of a metropolis firstly in the terms of population growth. Two hypotheses may be proposed. The first one is in terms of population distribution, and it means population distribution and housing stock distribution are definable according to the Poisson's probability distribution. Through time, parameters of this function change, indicating the metropolitanization process is current. In fact, it is a process of population concentration which develops up to a certain level, and after that stagnates or even declines, denoting the end of one developing cycle. It seems to me that the level of the normal distribution indicates the beginning or the first urbanization stadium of a metropolitan area. The second hypothesis indicates that the total urban growth (population and housing stock) is definable by the correlation of the probability integral of population and residential (building) density. The shape of these curves is "S" and it indicates when the development of one cycle will be finished. The section of these curves assigns the end of the time cycle. Defining of these integrals is conditioned by the site of the turning point in which the function changes speed, from increasing to decreasing. In a mathematical sense, it can be solved by iteration methods on the basis of the integral equation we propose and using, of course, computer techniques.

Population distribution in a metropolitan area represents a process in the time function, oscillating in the defined limits. Considering this process may be followed and measured on the basis of models of probability distribution, it is possible to define optimal limits of population distribution. The solution of this problem is based on two factors of influences: traffic, as a connector and an indicator of the metropolitanization process (distribution of working place) and population. Both are actors in this process. The solution implys finding the minimum integral of optimal distribution. It represents, in fact, volume integral determinable in limits from the center to the gravity of metropolitan influence limits. Numerical solution may be given by a specific alinear program, according to parameters which should be defined for traffic in advance.

The investigation of housing determinant distribution of the Belgrade metropolitan area showed the process of regional concentration in the ring between 25 and 35 km. Tendencies indicate the increase of concentration will continue farther, but dispersion is not exclusive. Hence, we need to pose a question: Should we follow manifested tendencies or, reversely, should we plan independently of them? In our opinion, stimulation of urban development according to manifested tendencies up to a certain level and with a defined aim may have high importance for developing countries, but also for developed ones, because it would mean first following the process and then direction in advance of the established sense. By that, potential power of the current process would be used instead to suddenly accomplish the redirection, demanding a large beginning impulse from the point of view of financial means, scholars and knowledge.

In contemporary comprehensive housing planning, space structure of cities and metropolises will have considerable importance because of growing needs of coordinated solving of disposition of objects and activities and people communication. It will be important for both developed and developing countries. In the first ones, exchange of urban structures in a revitalization sense is actual, the second ones expect acceleration of urban growth, stimulating economic and cultural development. Space structure of future cities should represent the skeleton of an urban system in which activities of working, living and housing should be organized with maximum comfort and opportunities for working and living choices and minimum loss of time and energy.

Three characteristics may be had by the estimation of space structures: 1) building density and the degree of usefulness of structure, 2) types, shape and infra-structure capacity, serving people communication due to different activities, 3) location of constant activities, particularly basic ones attracting large numbers of people.

Present city and metropolis should be investigated in benefit and efficiency aspects, including goals, interaction, cost, control, adaptability and continuity. Besides such empiric investigation, theoretical research should be done on theoretical models. In simulating of the real conditions in such an experiment, many necessary parameters should be given so empiry would be imitated.

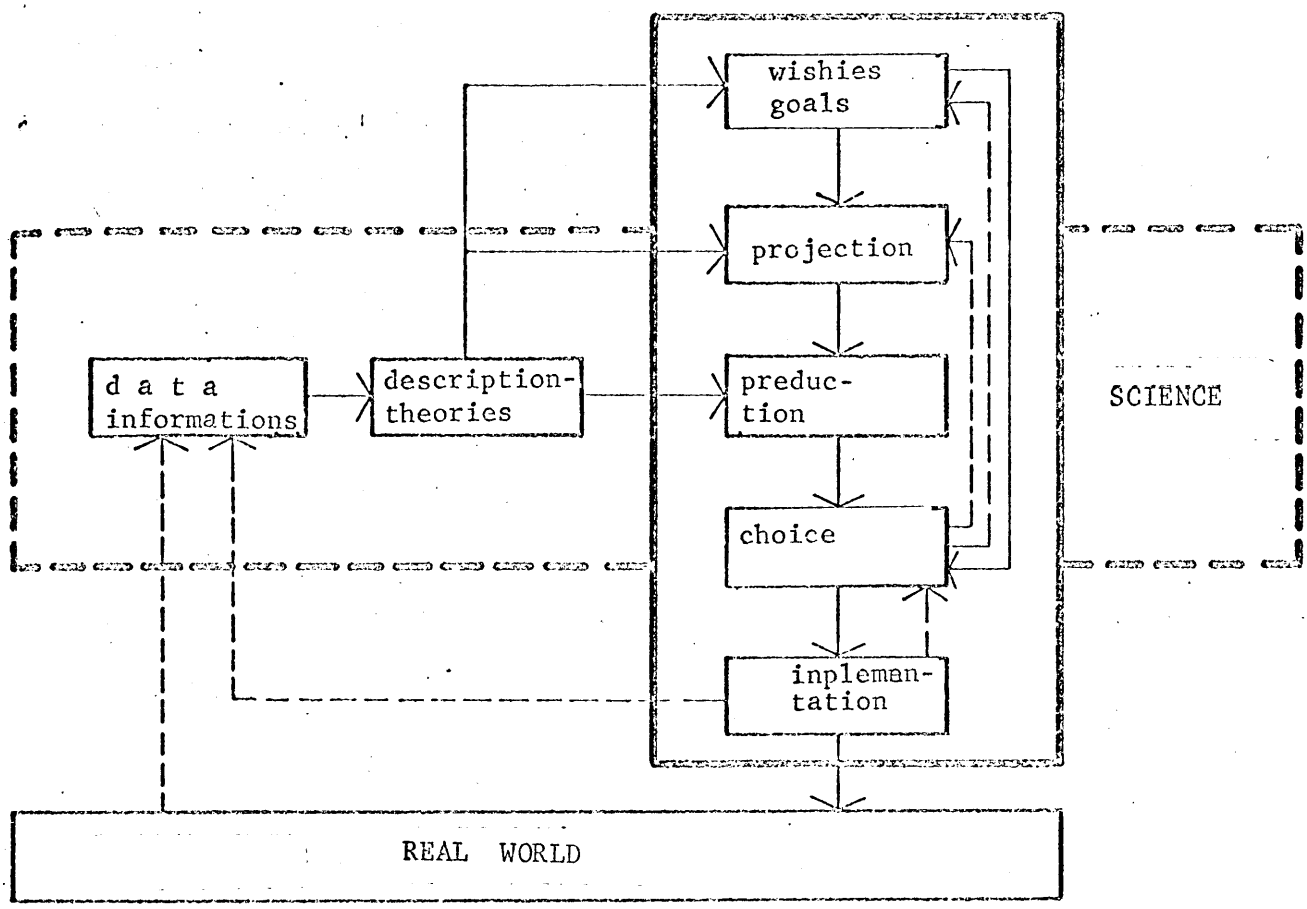
There are two kinds, but in its scope more types, of space structure of a metropolis. Among dispersion structures we may distinguish: grain, galazy, polycentric and linear structures.

These ones emerge from empiry or theory, but they regardless have advantages or disadvantages of housing and living organization in a city. Concentric structures surround star, ring and axis ones. For our investigation, ring structure is the most interesting considering it makes possible the modeling of urban equilibrium in a metropolitan area.

Urban development models in a mathematic-economic sense may have probability or construction (intervention) character, with or without the possibility of regional development direction. Depending on the metropolitanization process character, two kinds of models can be established: dispersion and concentration character. The second kind of models is interesting for our investigation because it responds to the implosive character of urbanization (in more points of area) and distinguishes the explosive urbanization which guides agglomeration dispersion in metropolitan and regional areas.

The model of urban equilibrium which we developed represents three kinds of linked equilibriums: demographic, economic, and functional. The demographic equilibrium is solved using principles of mechanic balance by the vector account. This equilibrium represents the base of establishing economic equilibrium. So, having in mind the location of secondary centers, mutual ones and according to the primary center, its population should be distributed by components according to mutual influence directions. Economic equilibrium is defined by the relatively closed urban system, principly in the new way: the economic power of the primary center should be opposed to the total economic power of secondary centers. Using principles of location theory, the gravity influence is changeable (decreasing) with the distance, and using the probability theory (Gaus' law of these changes) mathematical models of the equilibrium were established operating by employment and activity ratio in addition to income and population. Models are time-oriented, counting with input changes and operating cycles. Functional equilibrium implys function distribution in metropolitan centers so that circulation according to the metropolitan center will be reduced and balanced. The task consists of defining the gravity area of the primary and secondary centers according to functions which they get in the urban system. The solution is based on the intensity of communication and trip distributions. Stochastical law of these phenomena makes possible the defining of gravity influences and so serves as a good orientation in planning process. For instance, by Belgrade conditions the metropolitan gravity area represents the circle of a 40-km. radius (25 miles)

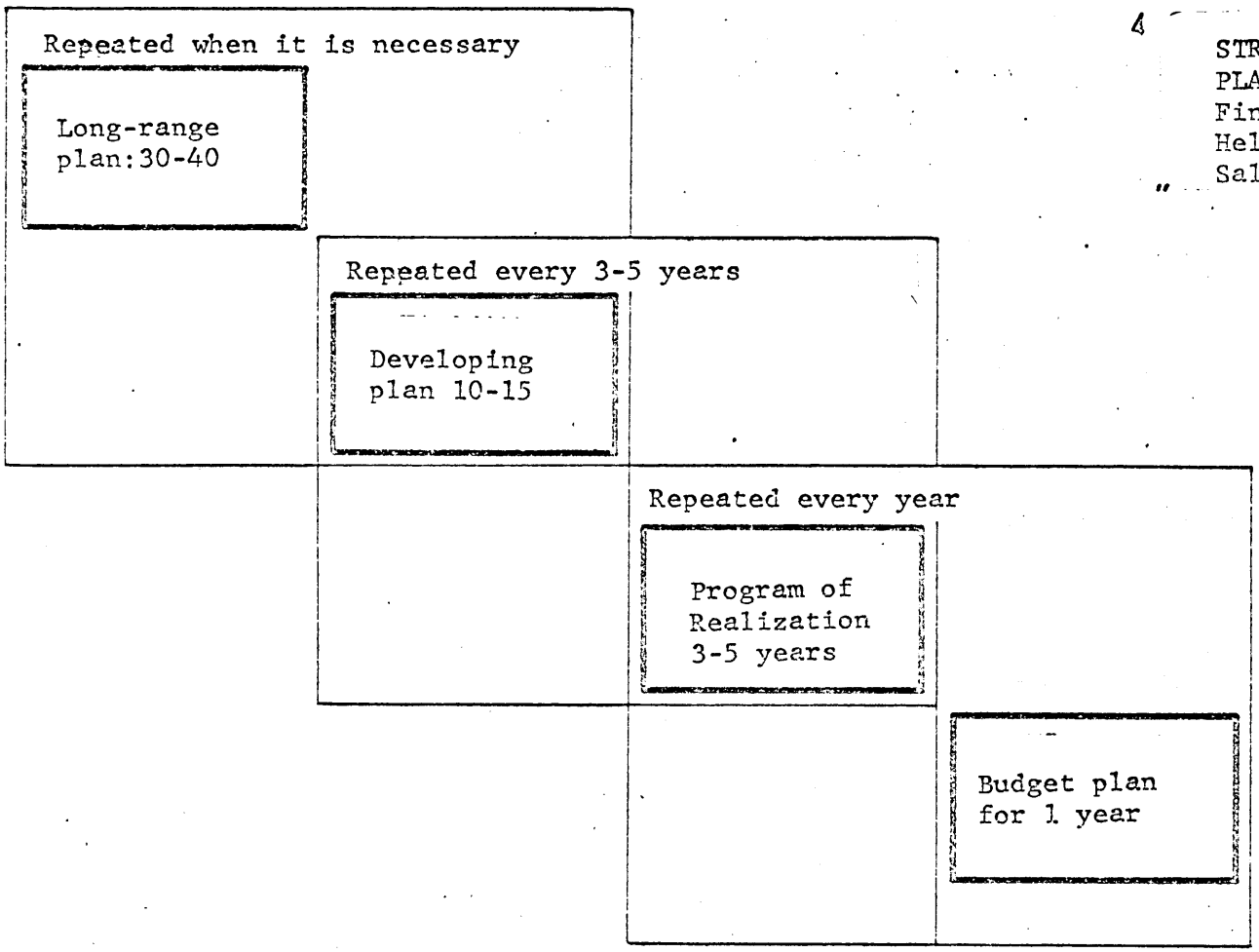
in which the area of homogenious influence distribution (85 percent of trips) has the radius of 20 km. (12.5 miles). Such theoretical investigation is almost completely identical with empiric investigation of the gravity influence in the metropolitan area of Belgrade, and it confirms the thesis about the combination of probability and intervention theories of urban development.

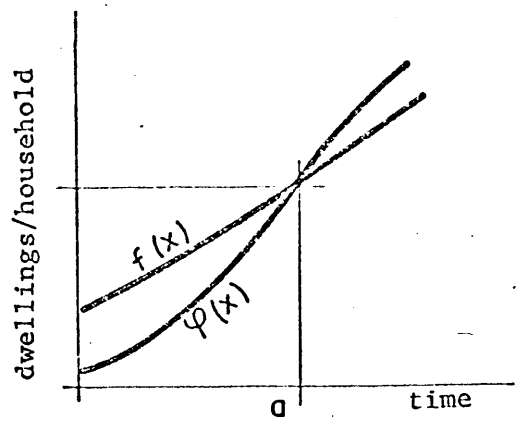


1

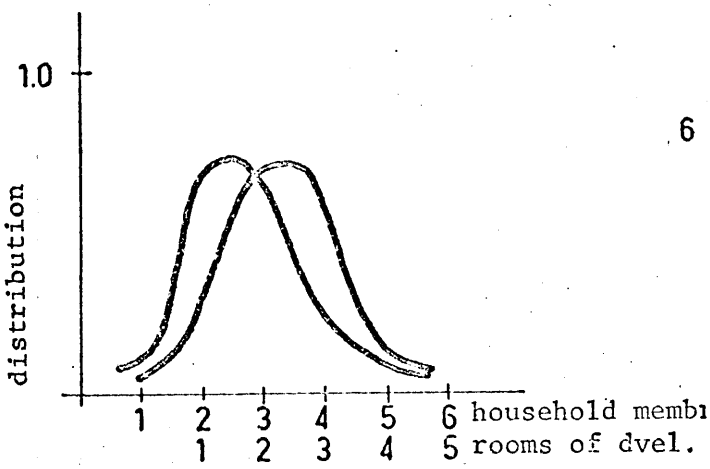
PLNANNING PROCESS-
PROF. B.HARRIS, JAIP 5/1967

STRUCTURE OF COMPREHENCIVE PLANS
Finland experience, E.Kallinen, Helsinki
Salzburg Seminar 1970

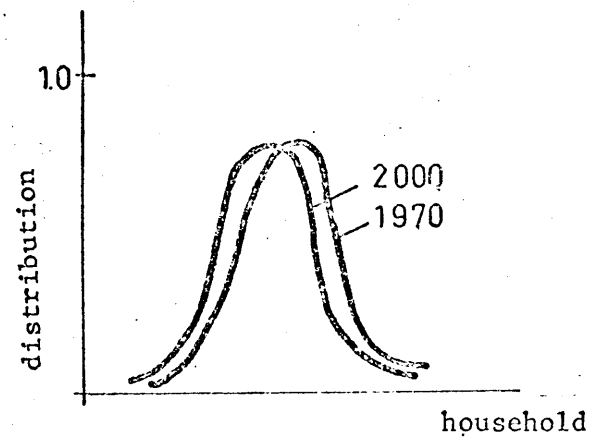




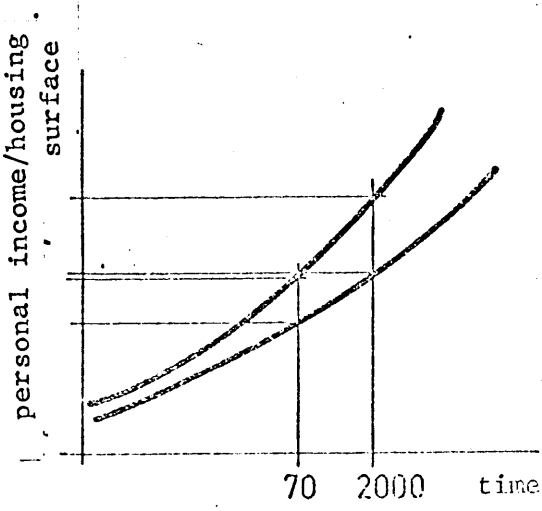
5 DIAGRAM OF THE HOUSING NEED QUANTUM



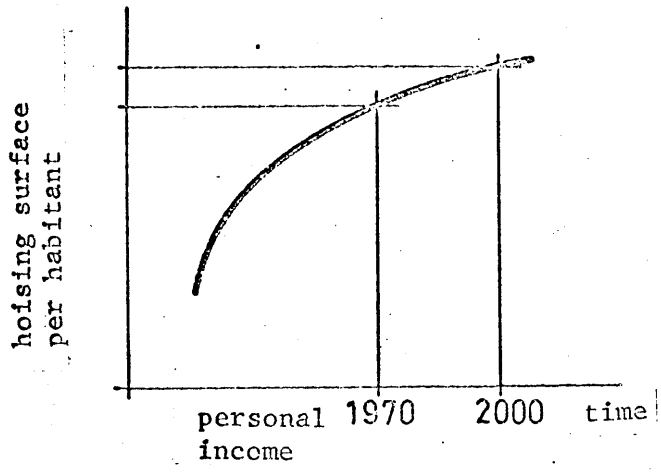
6 DIAGRAM OF THE QUALITATIVE HOUSING DEMANDS



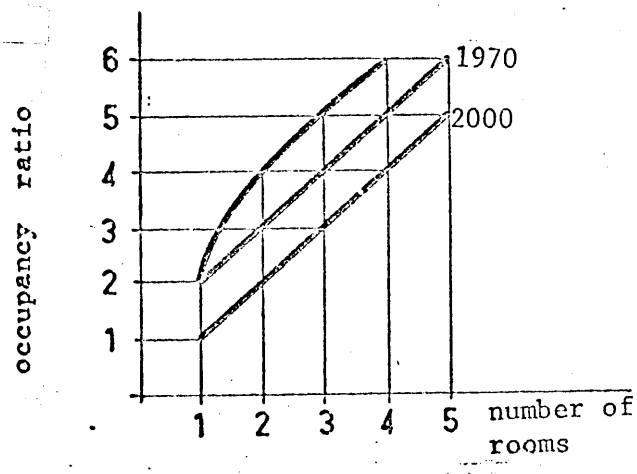
7 DIGRAM OF THE RELATIVE HOUSE-HOLD DISTRIBUTION, ACCORDING TO ITS MAGNITUDE IN THE TIME STRATUMS



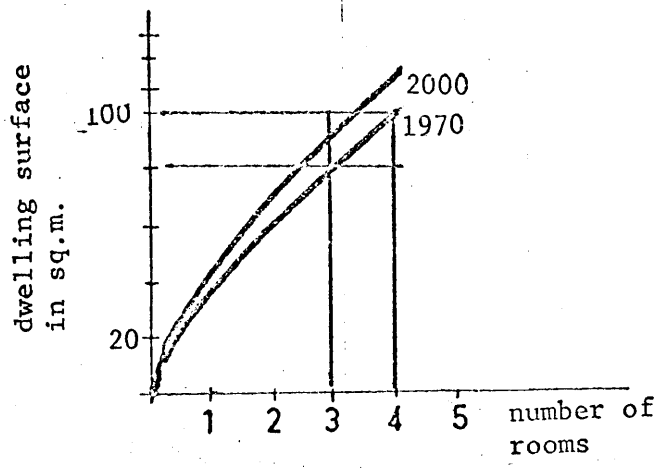
8 DIAGRAM OF PERSONAL INCOME AND HOUSING SURFACE TRENDS



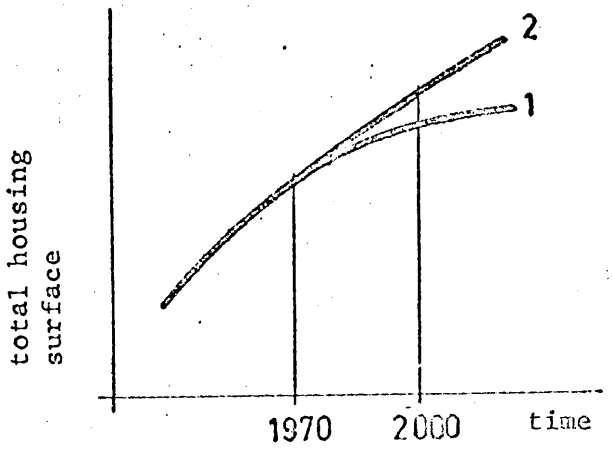
9 CORRELATION OF PERSONAL INCOME AND HOUSING SURFACE



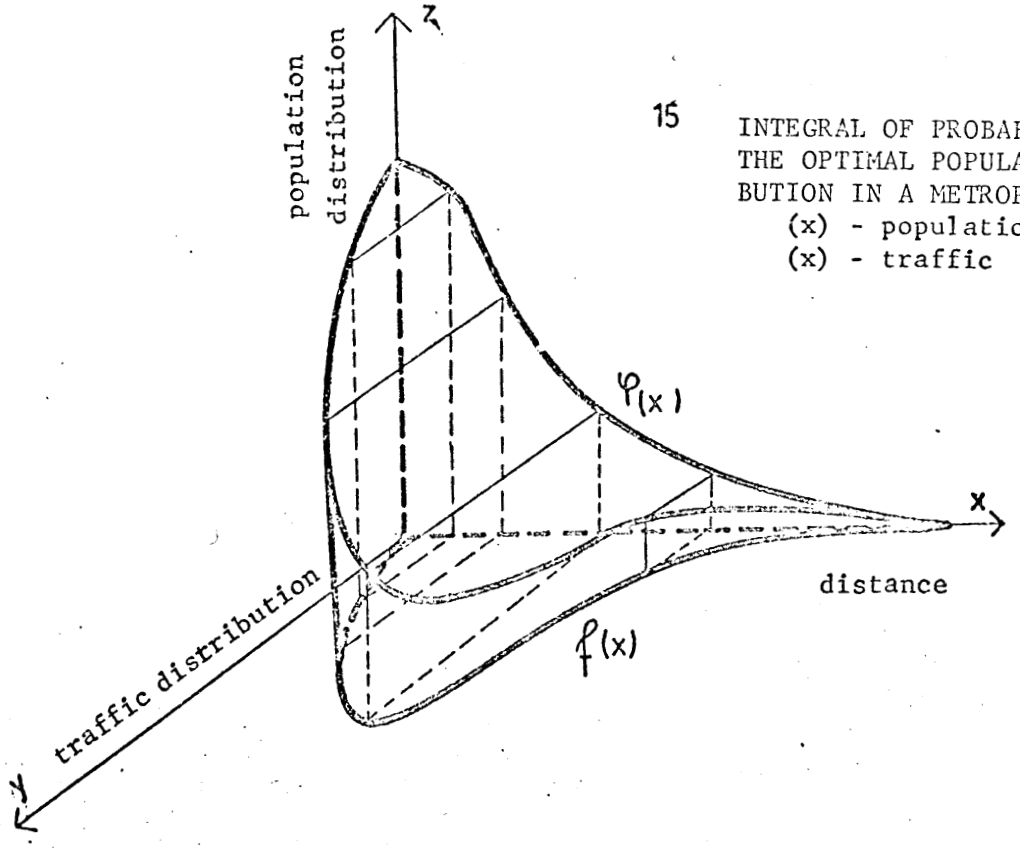
10 CORRELATION OF DWELLING MAGNITUDE AND OCCUPANCY RATIO



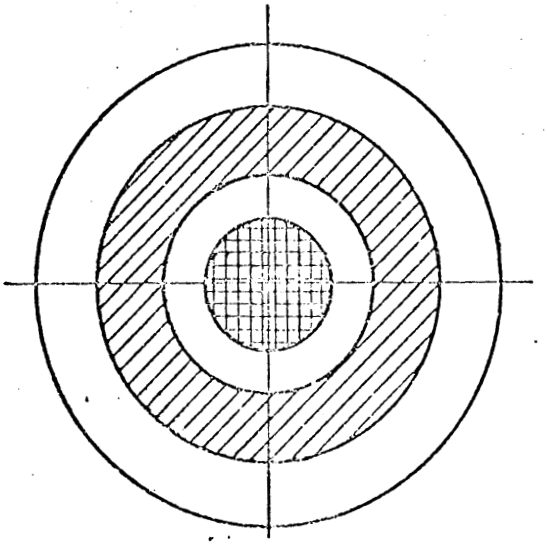
11 CORREEATION OF HOUSING SURFACE AND DWELLING MAGNITUDE IN TIME STRATUMS



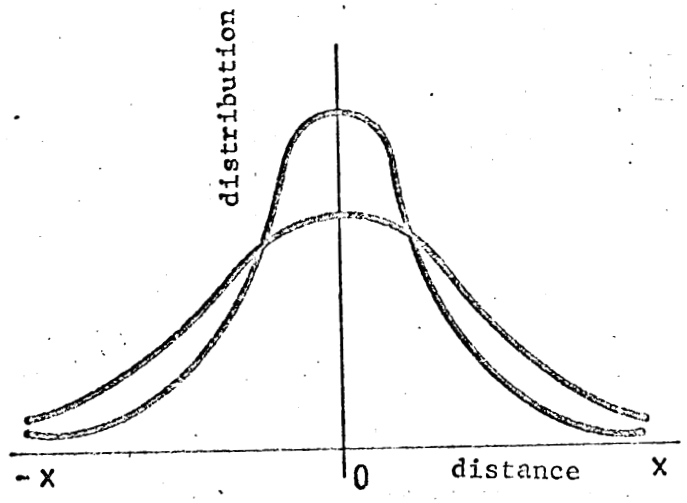
12 ALTERNATIVE TRENDS OF THE TOTAL HOUSING SURFACE



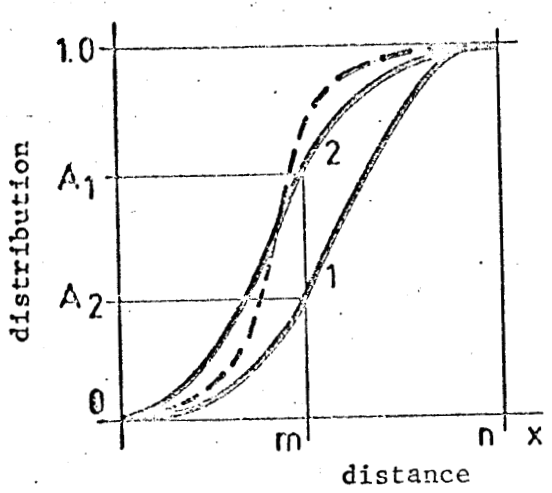
15 INTEGRAL OF PROBABILITY OF THE OPTIMAL POPULATION DISTRIBUTION IN A METROPOLIS
(x) - population
(x) - traffic



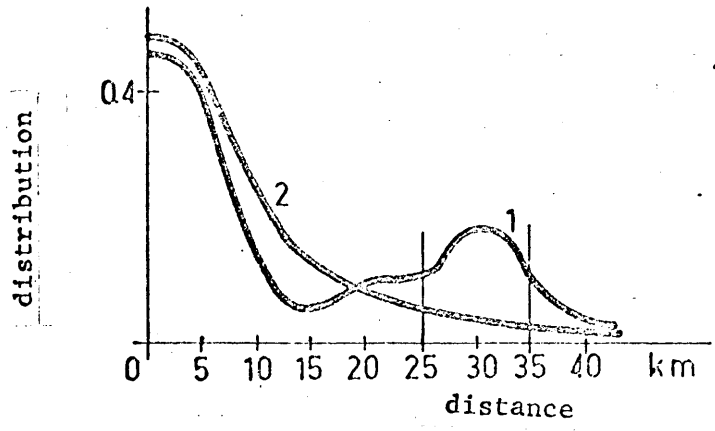
16 SCHEME OF THE RING CONCENTRATION IN BELGRADE METROPOLITAN AREA



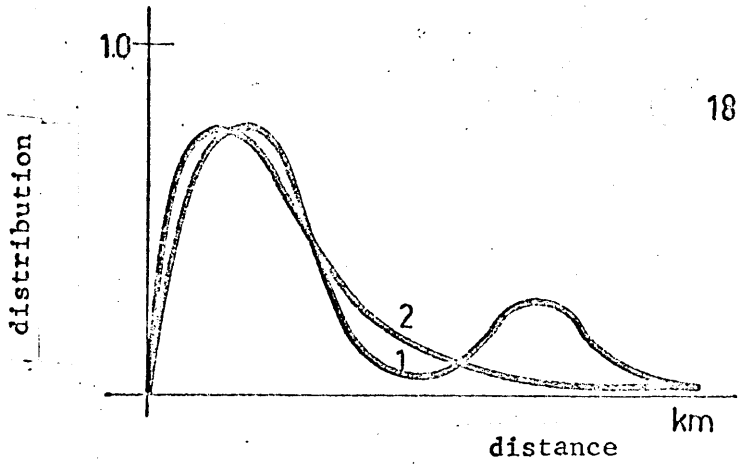
13 PROBABLE POPULATION DISTRIBU - I TION IN A METROPILIS



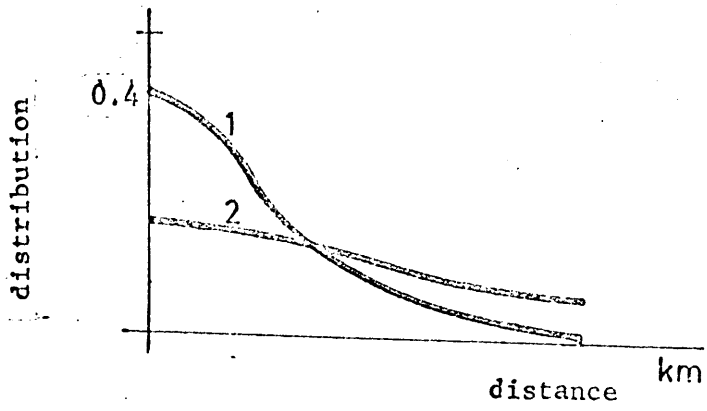
14 INTEGRAL OF PROBABILITY OF THE POPULATION GROWTH(1) AND THE RESIDENTIAL DENSITY GROWTH (2).



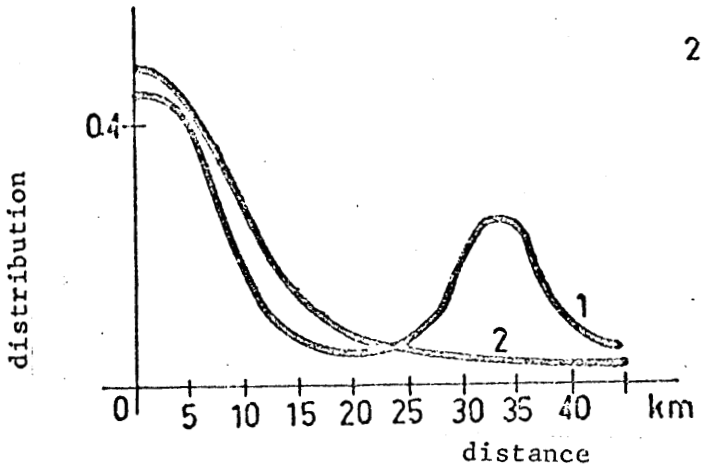
17 POPULATION DISTRIBUTION IN BELGRADE METROPOLIS
1- real and 2- average functions



18 TRIP DISTRIBUTION IN BELGRADE METROPOLITAN AREA
1- real and 2- average

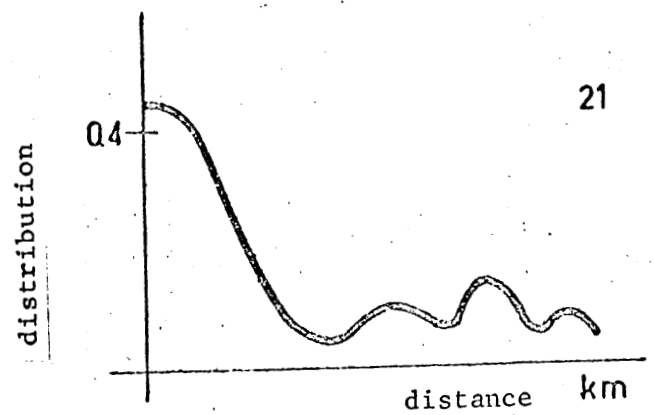


19 THEORETICAL POPULATION DISTRIBUTION IN BELGRADE METROPOLITAN AREA
1- normal, 2- proportional



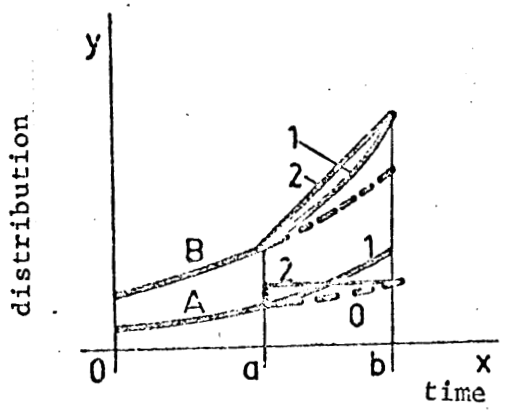
20

FINAL PHASE OF METROPOLITANIZATION PROCESS IN BELGRADE METROPOLITAN AREA
1- hypothesis, 2- average



21

POSSIBLE DISPERSION IN THE METROPOLITANIZATION PROCESS IN BELGRADE

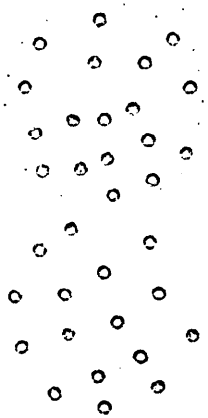


22

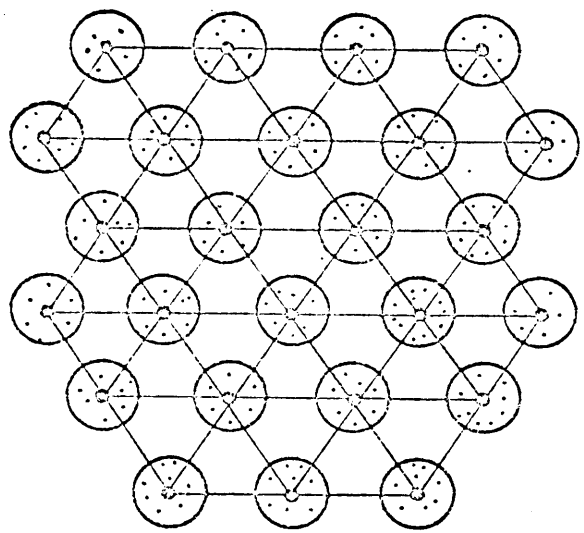
DIFERNTIAL (A) AND INTEGRAL (B) URBAN DEVELOPMENT FUNCTION
1- continual, 2-discontinual

23 DISPERSIVE STRUCTURE OF METROPOLIS. (After Kevin Lynch, The Pattern of Metropolis)

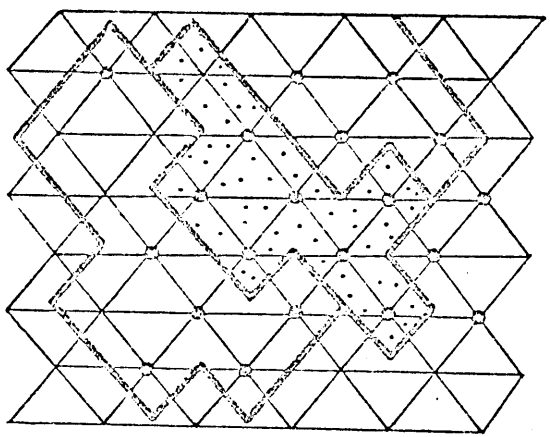
1. Grain



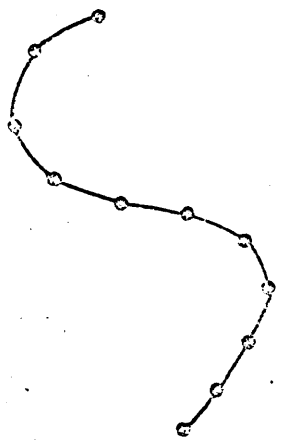
2. Galaxy



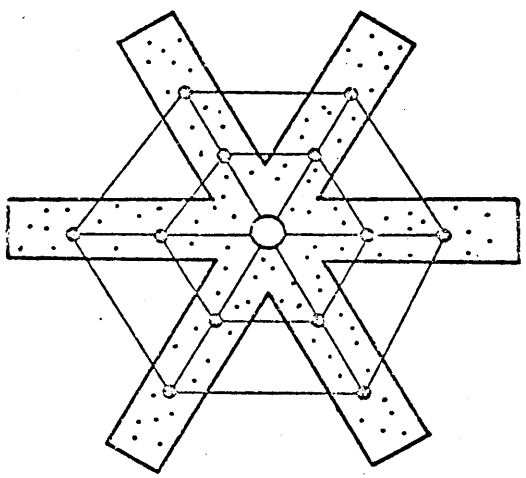
3. Polycentric



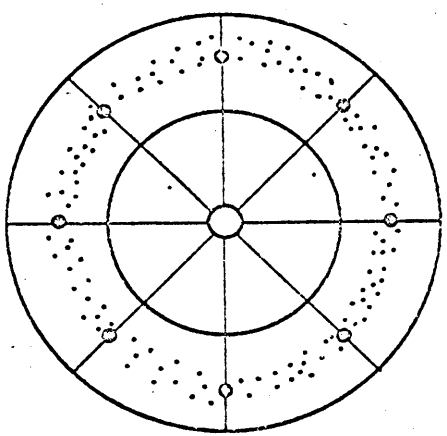
4. Linear



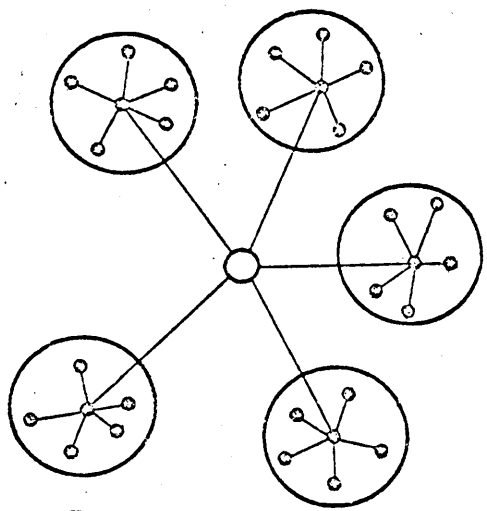
24 CONCENTRIC STRUCTURES OF METROPOLIS



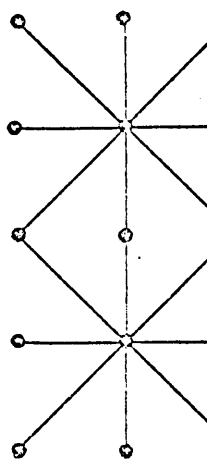
5. Star



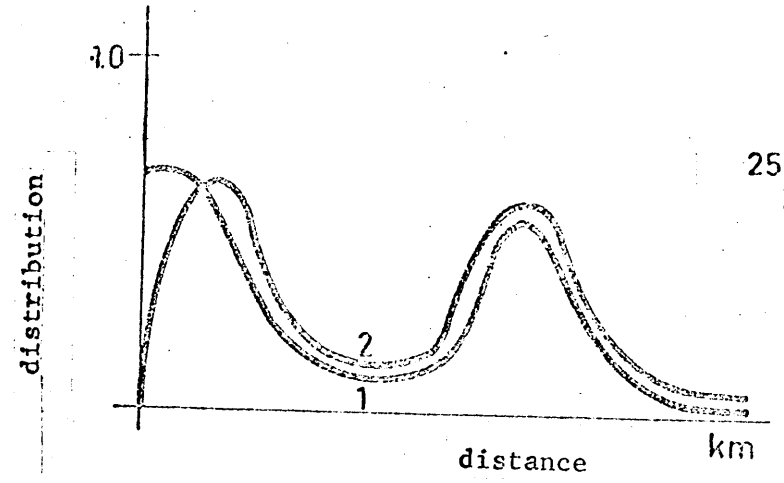
6. ring



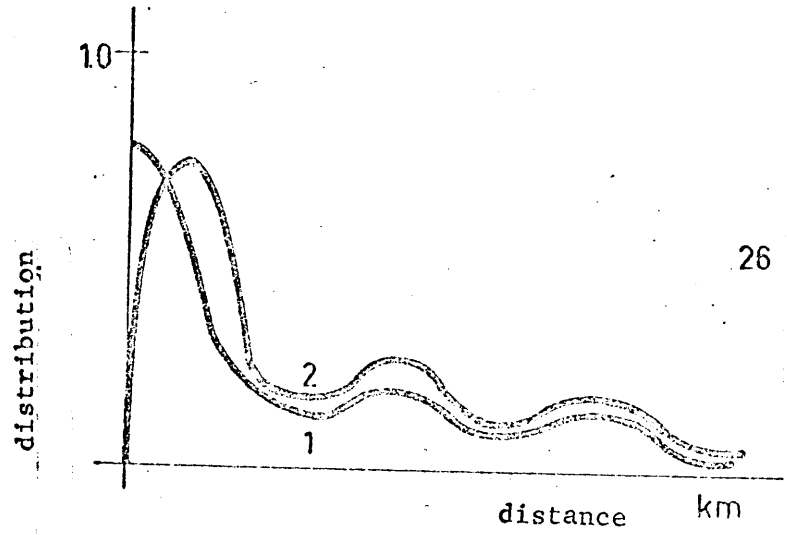
7. Focus



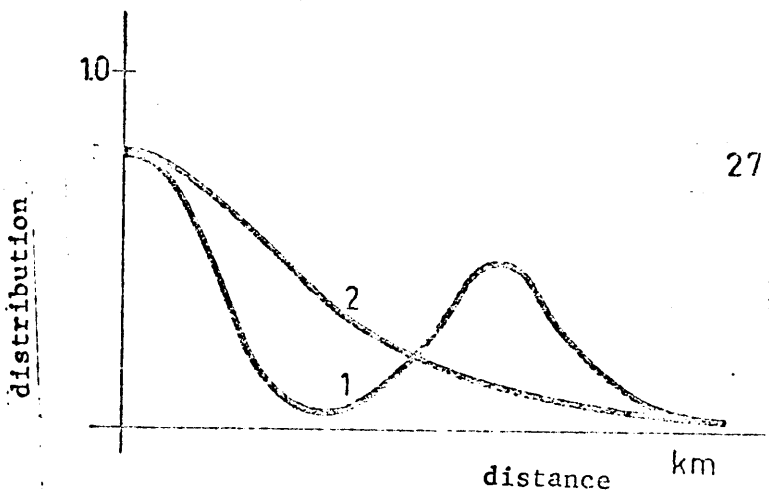
8. Axis



25 PROBABLE POPULATION AND TRIP DISTRIBUTION IN THE RING STRUCTURE OF METROPOLIS

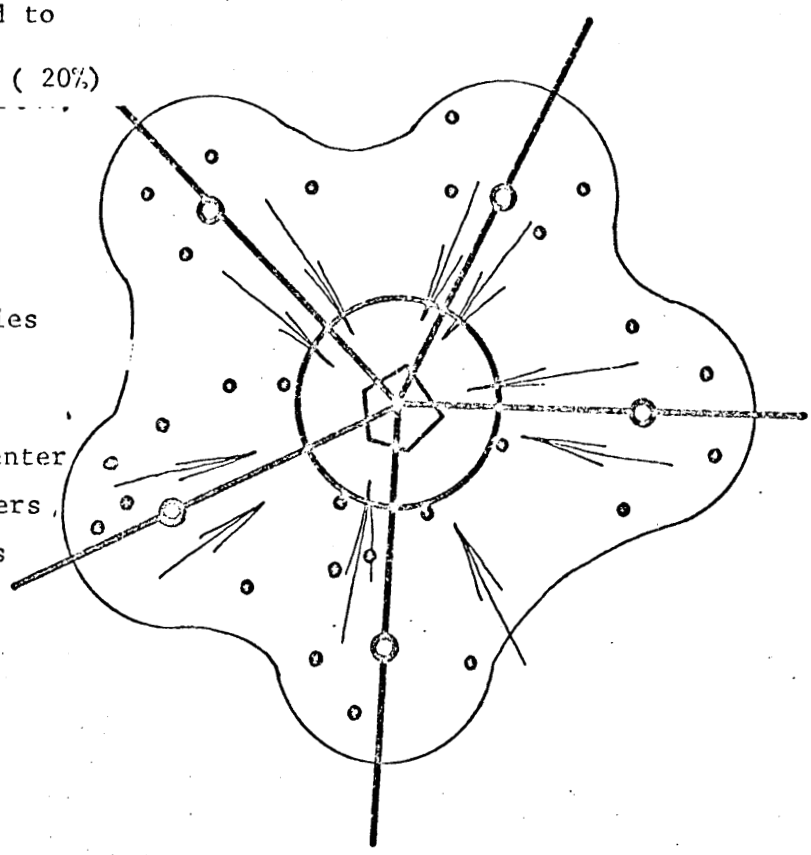


26 PROBABLE POPULATION AND TRIP DISTRIBUTION IN THE STAR STRUCTURE OF METROPOLIS

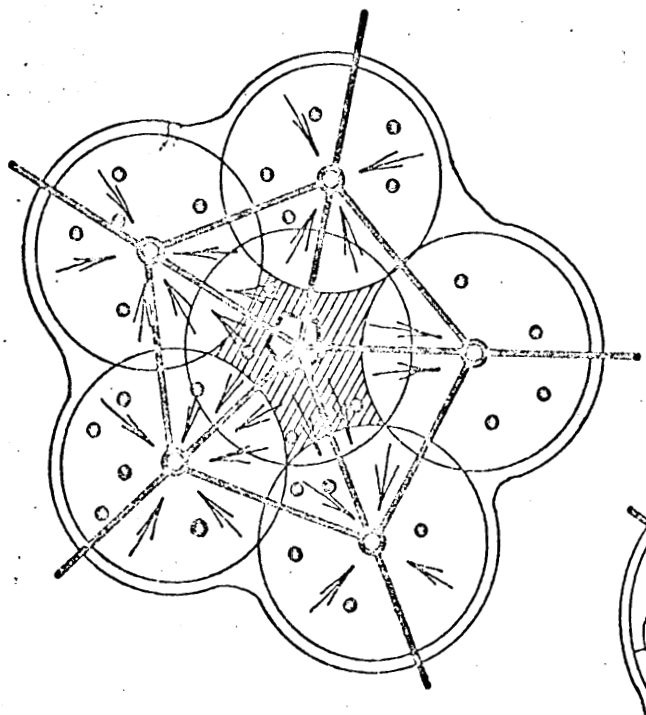


27 REAL (1) AND AVERAGE (2) POPULATION DISTRIBUTION

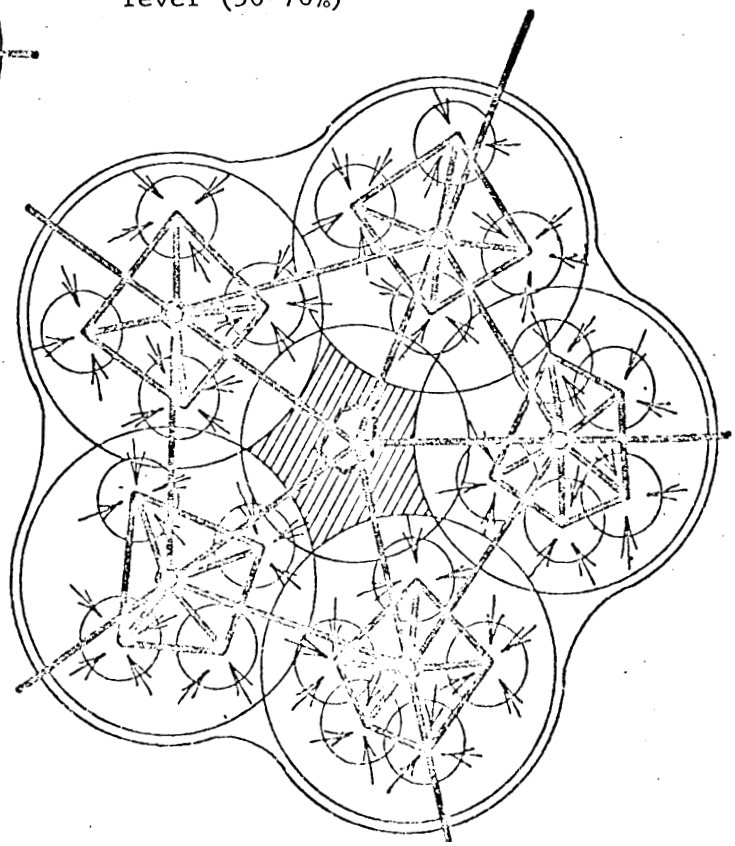
First phase:
Regional centers are not formed:
Migrations are diracted to metropolis
Low urbanization level (20%)



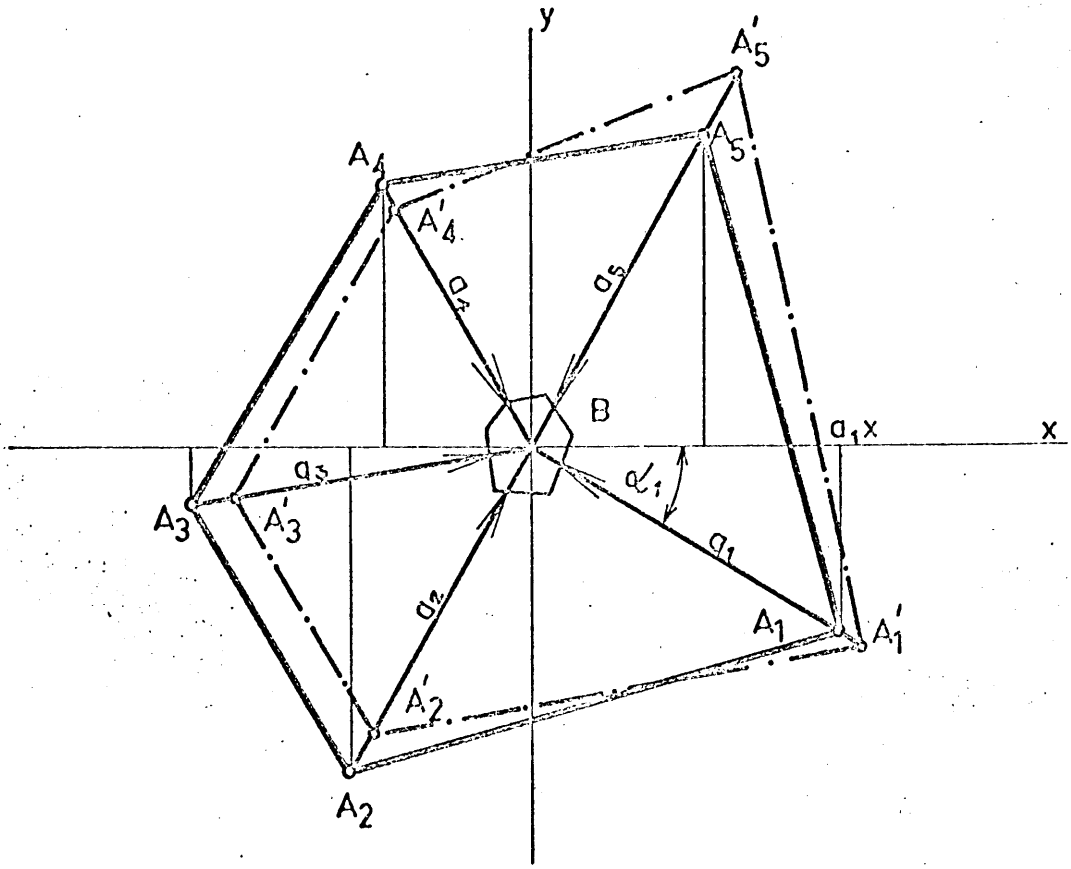
Second phase
Secondary centers are formed
Migration are directed to the secondary centers
Relatively high urbanization level (50-70%)



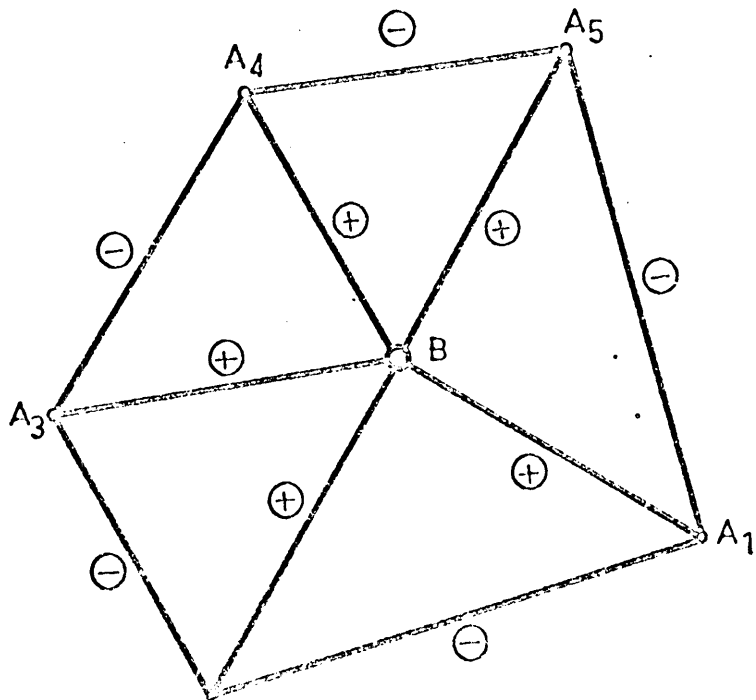
Third phase
Regional centers are formed
High urbanization level (80-90%)



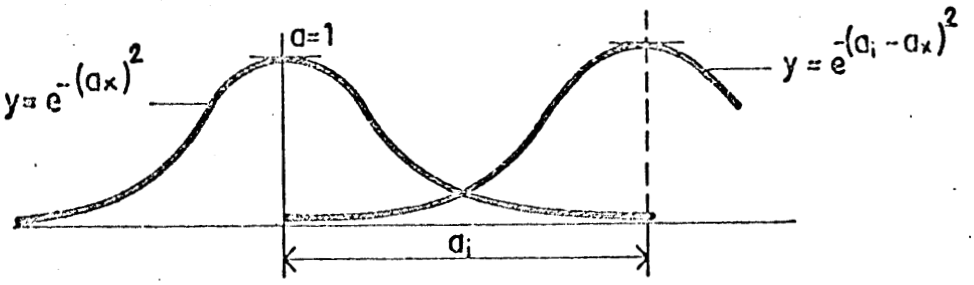
SECONDARY CENTER POPULATION



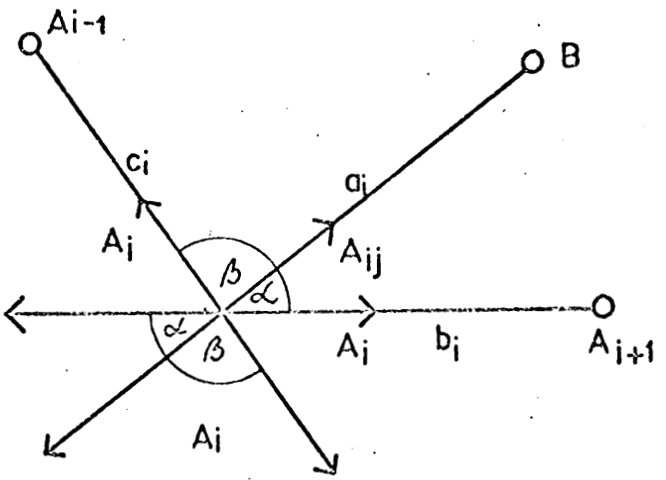
30 CHARACTER OF THE GRAVITY INFLUENCE OF THE POPULATION MASS IN THE VECTOR POLYGON

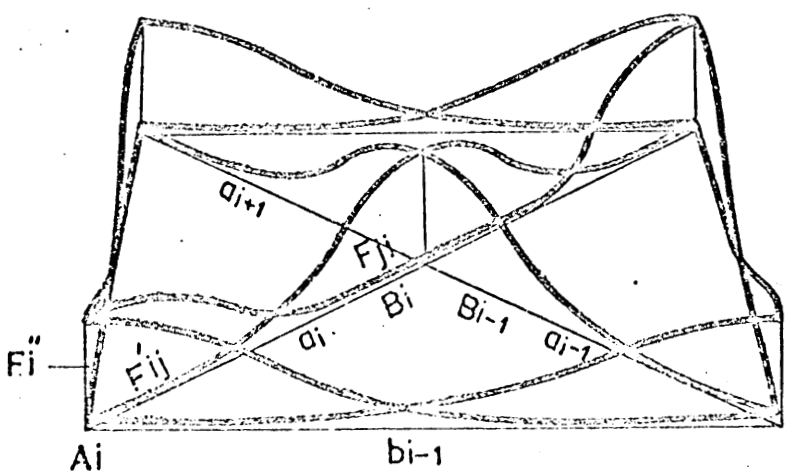


.31 INFLUENCE BETWEEN TWO CENTERS
ACCORDING TO GAUS FUNCTION



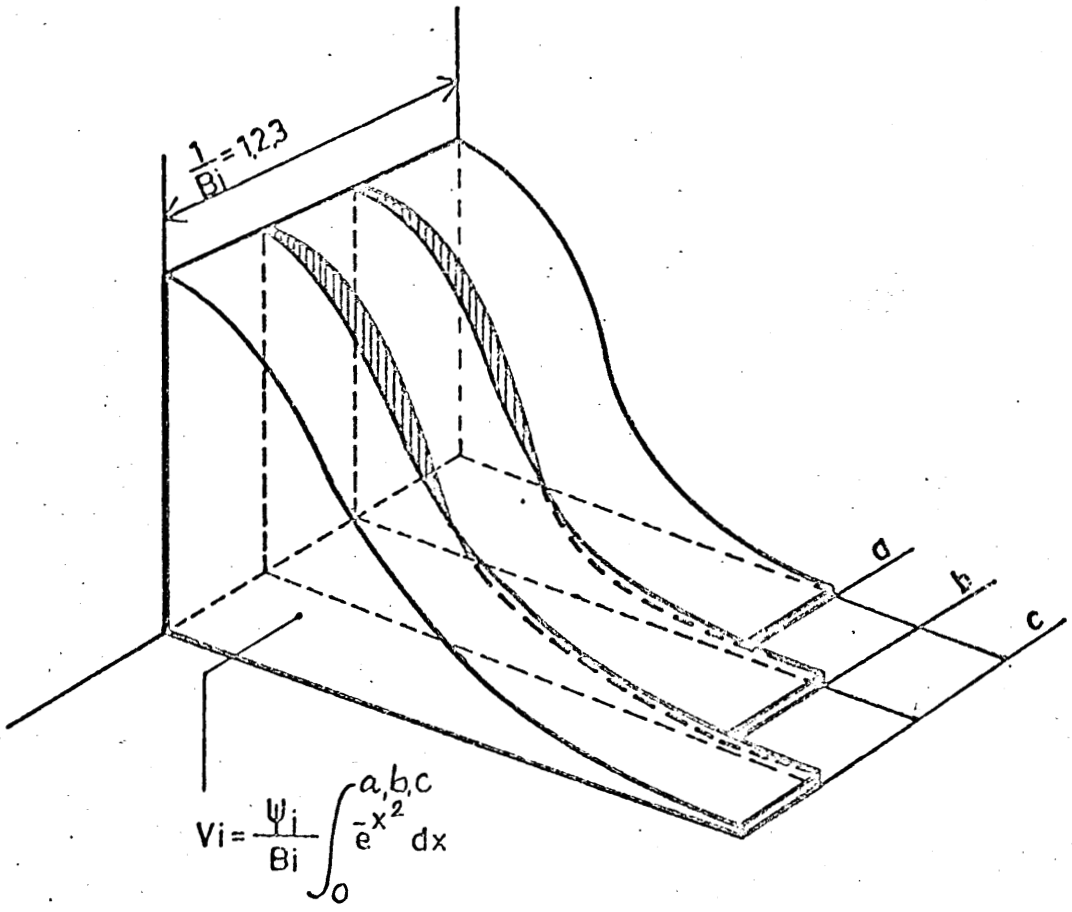
32 SCHEME OF THE INFLUENCE SPLIT
OF ONE SECONDARY CENTER



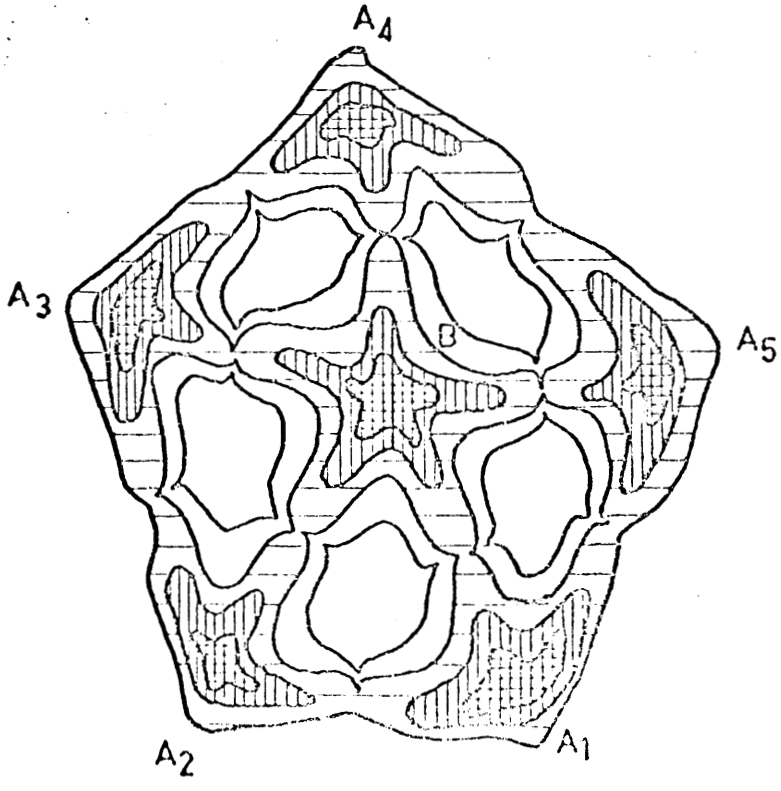


.33 ECONOMIC INFLUENCE SPLIT IN
THE SPACE

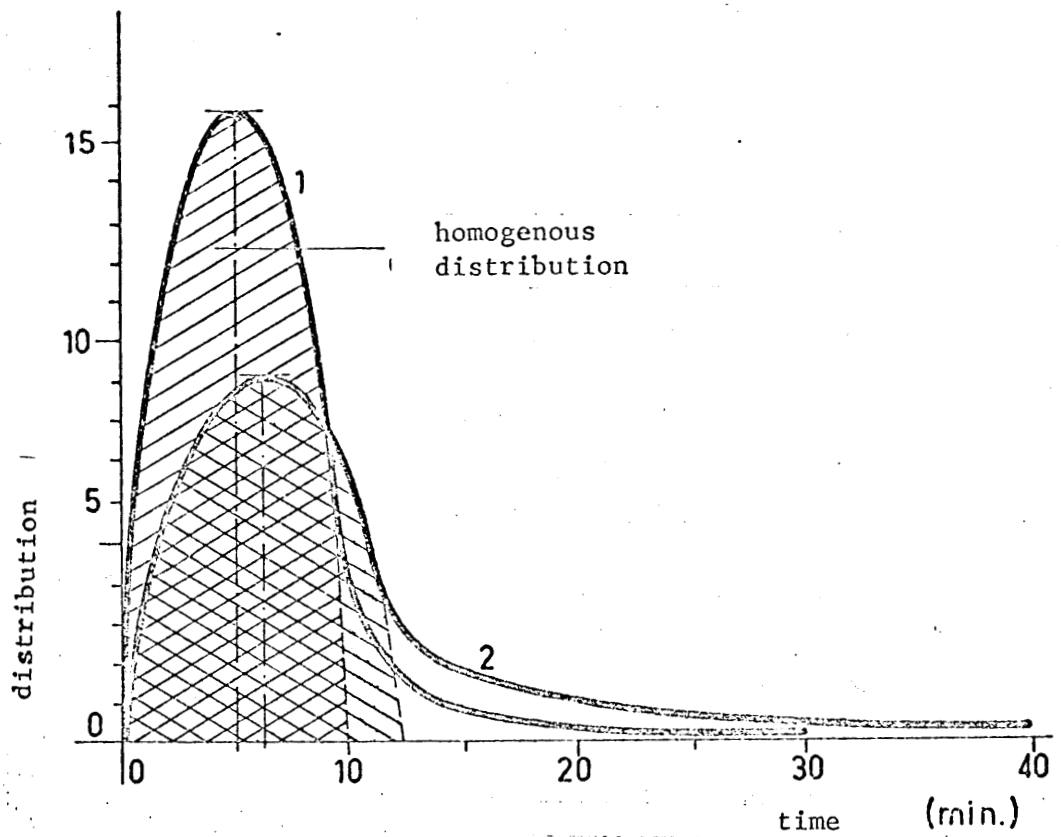
FLUENCE DISTRIBUTION



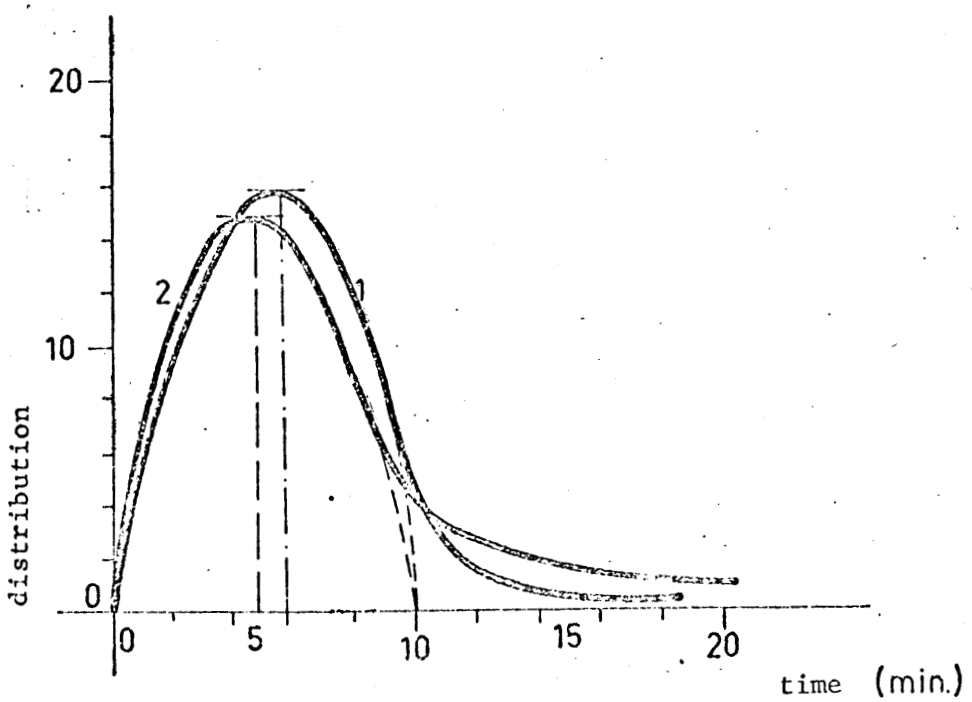
35 ISOGRAM OF THE ECONOMIC INFLUENCE EQUILIBRIUM IN A REGION

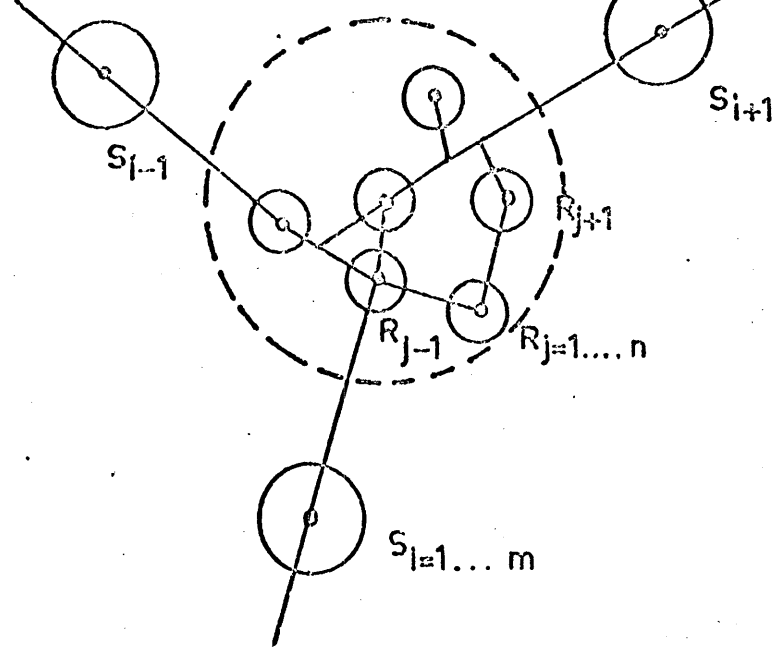


36 TRIP DISTRIBUTION IN SMALLER (1) AND LARGER AREA (2)

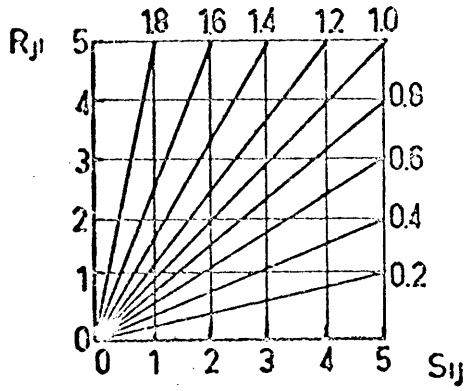


37 TRIP DISTRIBUTION WITH THE WORK PURPOSE AND REST

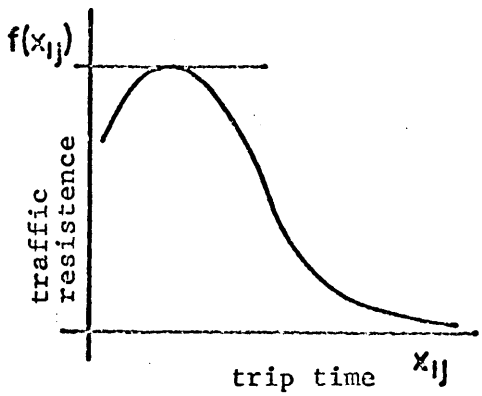




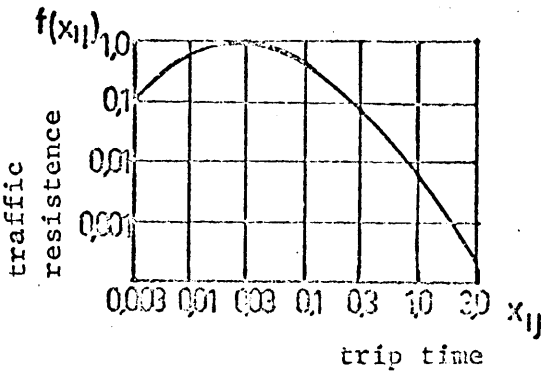
SPACE SCHEME OF THE RELATION BETWEEN HOUSING AND WORKING PLACES
Si - housing, Rj - working places



NOMOGRAM OF THE PARTIAL EMPLOYMENT PROBABILITY (ij)



40 DIAGRAM OF THE TRAFFIC RESISTENCE IN THE EXPONENTIAL FORM



41 DIAGRAM OF THE TRAFFIC RESISTENCE IN THE LOGARITMIC FORM

4th Part: METHODS OF HOUSING PLANNING IN A CITY - RESUME

Housing in a city should be solved in a comprehensive way: social, economical, and technical from the point of subject view and on different space levels: city, rayon, quarter, and settlement. Housing planning theory should surround several groups of problems such as: 1) principles, normatives and standards, 2) city space structures, 3) optimalization of residential zones, 4) planning of residential settlement structures, 5) building cost of settlements and cities, 6) conditions and possibilities of city housing renewal.

Contemporary housing organization should imply forming of urban units on different space levels. The basic planning unit should be the settlement - residential commune. Higher units would be the quarter, rayon zone, and city. Housing as a function transforms, across neighborhood units, from the urban-architectural in the architectural-building problem. Housing planning should be based on principles, normatives and standards established in advance. Principles should relate to differentiation of housing urban units as a result of the balance of economic possibilities and social needs. It would imply establishing of technic-economic and sociological factor influences in the defining of the content of facilities and services.

Principles should also influence the decision for definite types of residential houses, as well as for building-technological structures of houses and harmonizing with needs and possibilities.

Planning standards should provide adequate hygenic-biological living and housing conditions.

Normatives should influence the defining of urban structures providing satisfying housing conditions in a functional sense, as well as rationality of building and operating.

Planning techniques should imply criteria for defining of dimensions and urban structures which should also be a result of technic-economic and sociological factor influences.

Further urbanization process in Yugoslavia indicates small and average cities as possible and probable epicenters of urban development. Because of this, experiences of new cities planned and built recently in Sweden and Great Britain are interesting. They represent a life laboratory which examines contents, concepts and techniques. Space structures of these cities developed

in two basic directions according to garden-city and linear city. There is its combination as a regional city. Such an example is a group of cities: Northampton, Betfort and Bletchlay in Great Britain.

New cities in Great Britain and Sweden have relatively small magnitude of 65-90,000 people and 10-30 sq. km. (4-12 sq. miles). According to the space concept, British cities are nearer to garden cities, Swedish to linear ones. The concept of cities, such as Harlow, Runcorn, and Skelmersdale are based on the neighborhood unit. The concept of cities such as Cumbernauld and Wellingby group is different, the first as a concentric structure, and the second as a linear-dispersion structure. All these cities represent interesting experiments with different basic concepts: housing organization by neighborhood units, differentiation of vehicle and pedestrian traffics, and activity dissemblance of the central city.

General housing planning should operate with higher urban units, such as quarter and rayon, defined in view of magnitude and content. Investigation and establishment of these elements as well as planning criteria, represent a complicated and large account. At this moment it is not possible to differentiate rayon and quarter in an analytic sense, especially in view of contents and functions. Hence, the rayon will be observed as an important urban unit. In view of space structure, there are three types of rayon: concentric-radial, linear-radial and linear-tangential. Its characteristics are determined by the location of basic planning units (residential commune) and the traffic structure. The magnitude and the structure of a rayon should result from technic-economic and sociological factor influences. In order for such an analysis to be simplified, it would be necessary to investigate at least two factors, i.e. building cost and traffic cost (the second is indicated by passenger-km.). Considering that these two factors change differently, depending on the magnitude, the optimal magnitude of a rayon may be determined on the basis of their correlation.

Planning of a settlement (residential commune) should be based on parameters, measures and criteria in view of the space concept, functions and contents, magnitude and urban structures.

The neighborhood unit concept is four decades old. In the past it has not been essentially changed but it nevertheless has developed in an adequate way. The residential commune, responding to the neighborhood unit concept, should be planned on the basis of normatives defined in advance and harmonized with concrete conditions.

There are two kinds of normatives: constant and variable. The first group surrounds the school complex, services and social facilities, recreational surface, and parking space. The second group surrounds residential houses and street surfaces. Variable surfaces depend on residential density, respectively settlement urban structure. Depending on residential density changes, the relation between particular urban components changes. In a settlement of lower residential density, the residential part is predominant. Reversely, in a settlement of higher residential density the nonresidential part is predominant. Planning of a settlement urban structure may be relatively simple on the basis of established diagrams, normatives and settlement surface distribution designed in the residential density function.

The field of city and settlement building costs is as yet more noninvestigated than investigated, particularly in a theoretical sense. Operating costs are also little explored. On the basis of Swedish research, as well as our own, we concluded that residential density and magnitude (area) considerably influence relative building cost (unit cost) of variable components. After Swedish exploration, infra and superstructure building cost of settlement represent 60 percent of the total investment of city building.

City renewal should be solved in the context of urban development of the whole city, and housing reconstruction should be solved in the context of city renewal. The basic goals of city renewal should surround at least three groups of problems: communal facilities, traffic, and urban structure. One of the fundamental tasks of city renewal should be the redistribution of housing and demographic structures on the basis of three kinds of efficiency, i.e., traffic, land use in space sense, and land use in economic sense.

Investigation of traffic efficiency should imply the distribution of population in different social characteristics, as well as trip distribution with a different purpose. Observing changes through time, tendencies can be established as well as future moving forecasted. On the basis of the optimal integral of distribution, it would be possible to accomplish suitable redistribution of population in a city.

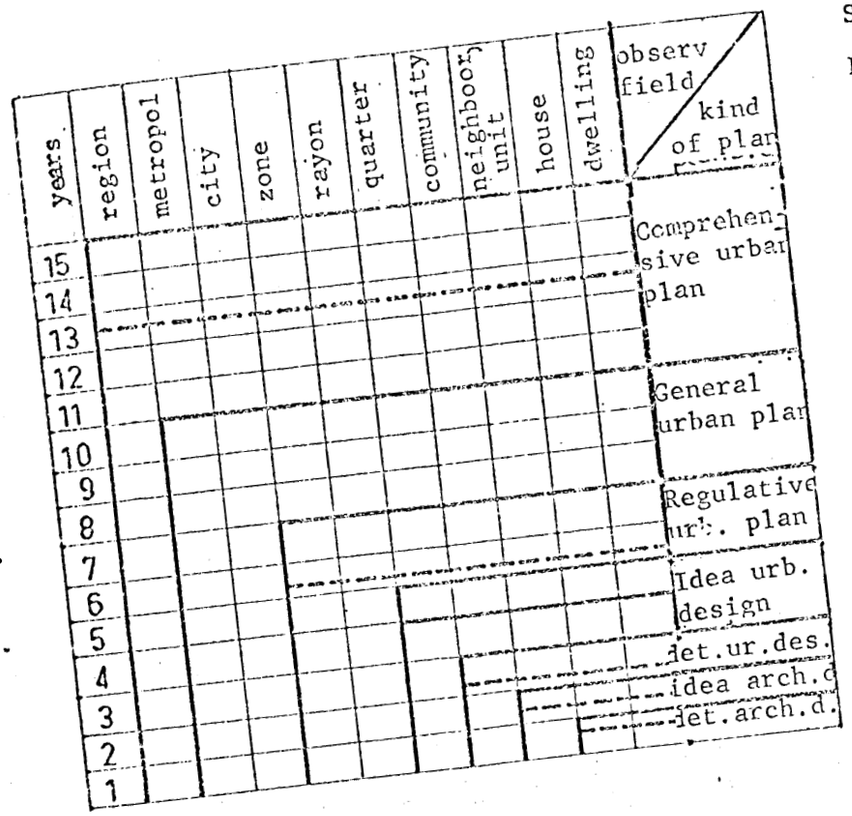
Space efficiency of land use should be examined on the basis of the density indicators (residential, building, and housing) as well as defined criteria. Using a statistical analysis, it would be possible to define the declination of given related to some standard rates, therefore concluding renewal conditions.

Economic efficiency of land use should be examined according to the land use criteria defined in advance, which should surround all activities.

Investigation of housing reconstruction conditions should be based on criteria and normatives defined according to local conditions. Anyway, these normatives should be more tolerant when the building of new settlements and cities are in question. On the basis of indicators such as land use coefficient and land use ratio, which represent the correlation of more parameters (the relation of the residential and non-residential part of the settlement, floor number and open surface around houses), it would be possible to establish or test suitable relations of these parameters for conditions given in advance such as residential density and building density. The next step in the analysis of renewal conditions should be the examination of conditions for exchange of the amortized housing stock, repairing of deteriorated houses and modernizing of substandard houses.

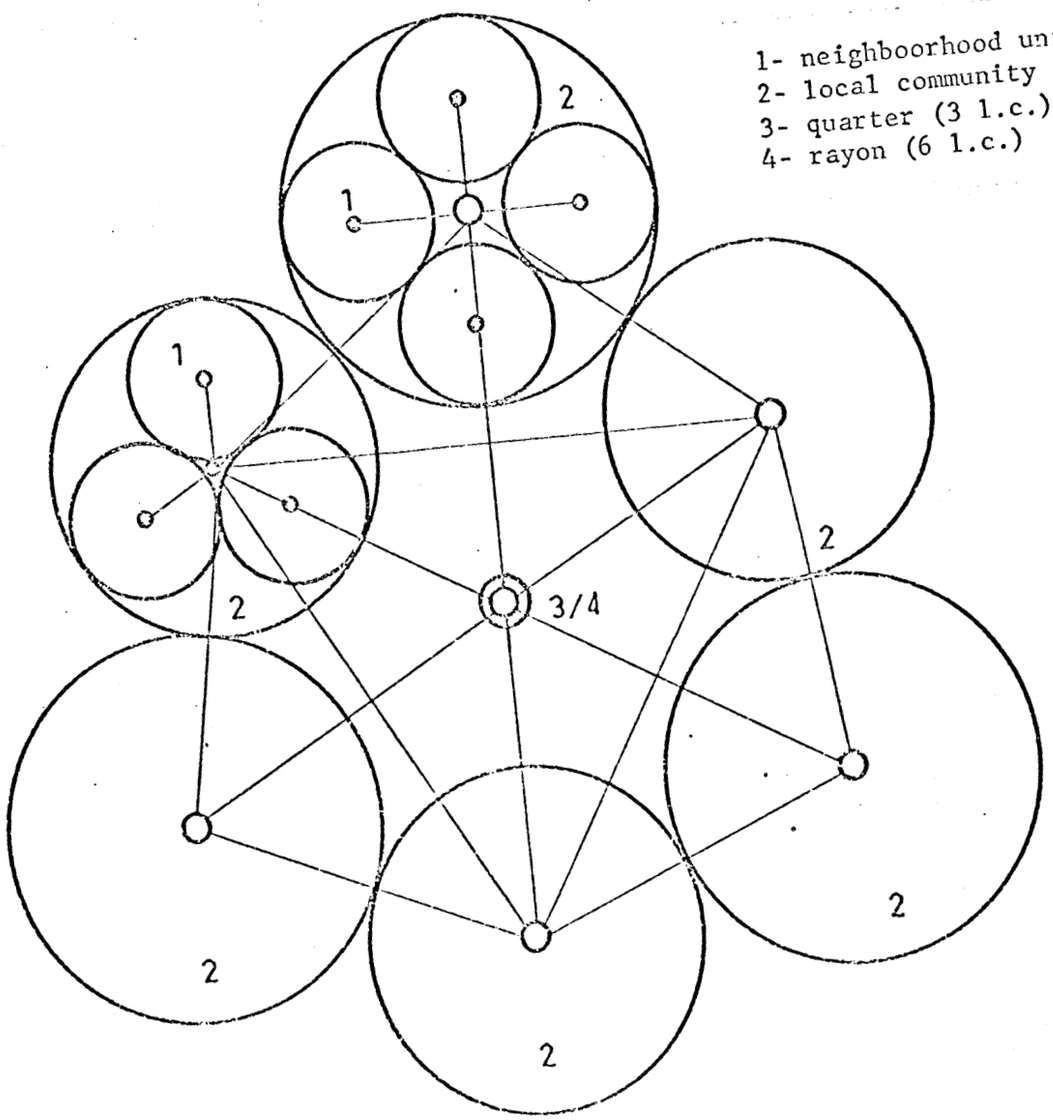
Finally, it would be necessary to establish the optimal period of housing stock exchange. Having in mind that operating costs of houses change according to the law of probability integral, it would be possible to shorten the amortization period by exchanges of parameters of this curve. It would imply changes of building material quality so that the total economic efficiency would be satisfied. The shortening of the amortization period may have a sociological sense, i.e., building adjustment according to social needs. But in a building-technical sense it may be particularly important. It would mean complete exchange of conditions for the planning and building of residential houses.

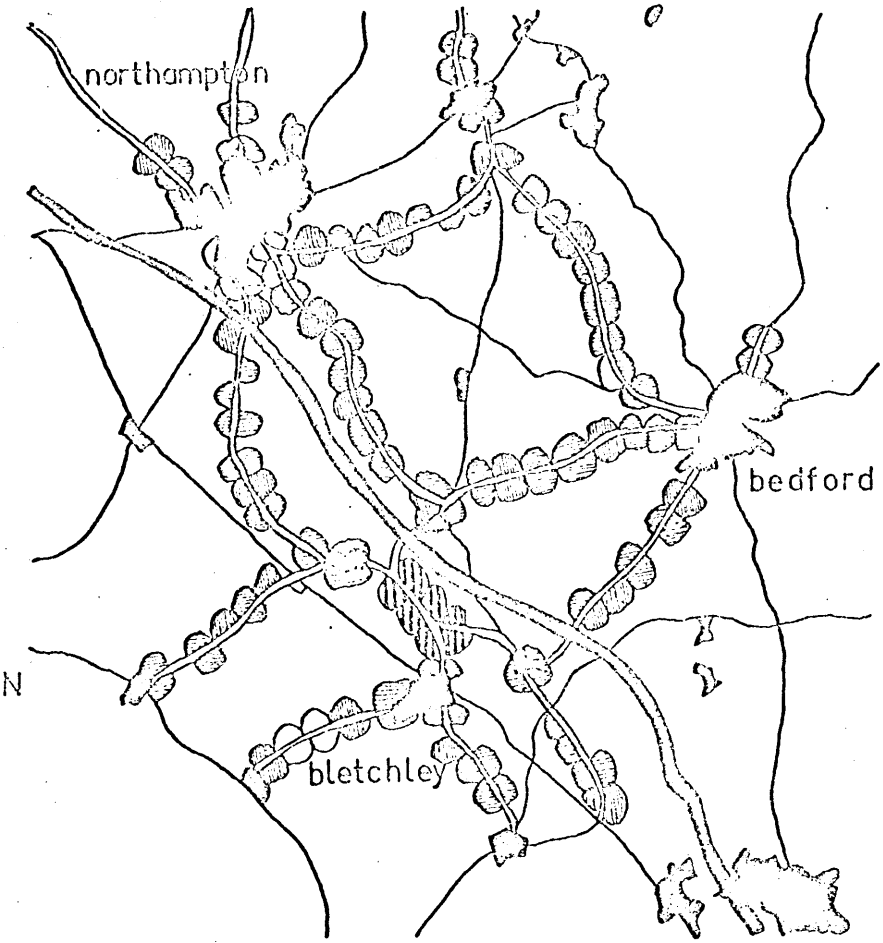
SCHEME OF SPACE PLANS DEPENDING ON PLANNING FIELD AND MAKING TIME



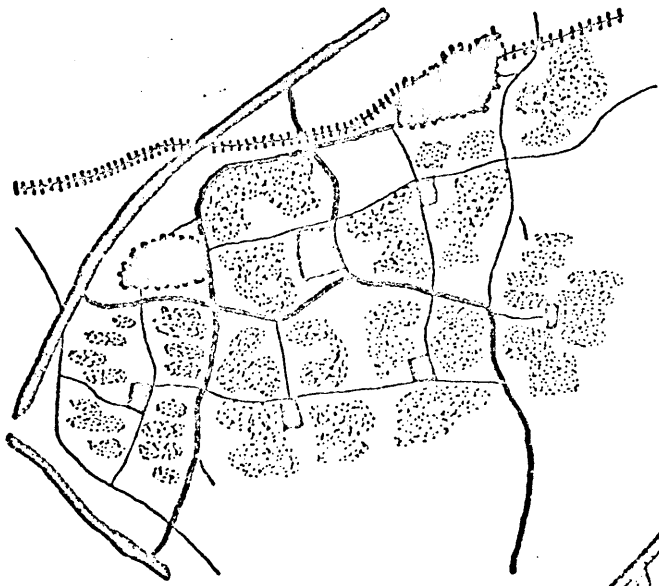
SCHEME OF HOUSING URBAN PLANNING UNITS

1- neighboorhood unit
2- local community
3- quarter (3 l.c.)
4- rayon (6 l.c.)

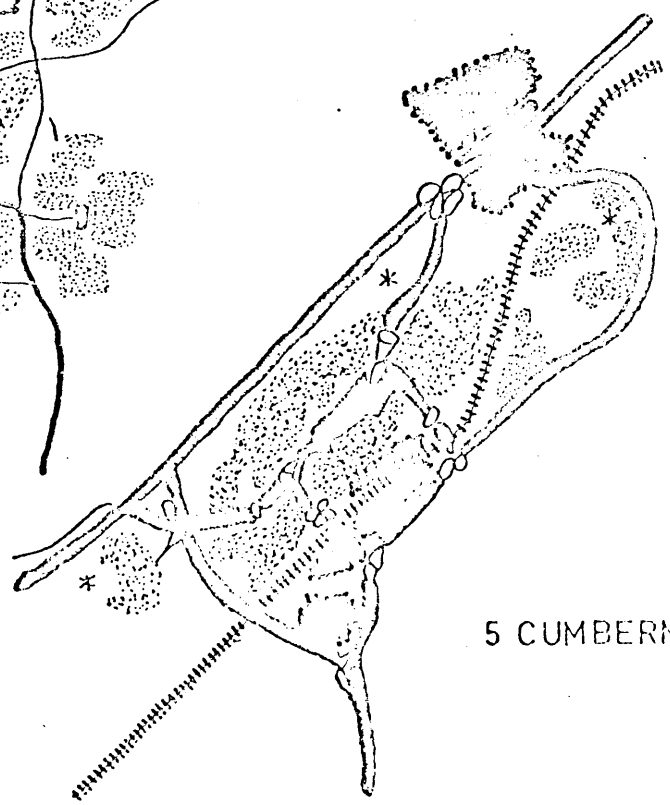




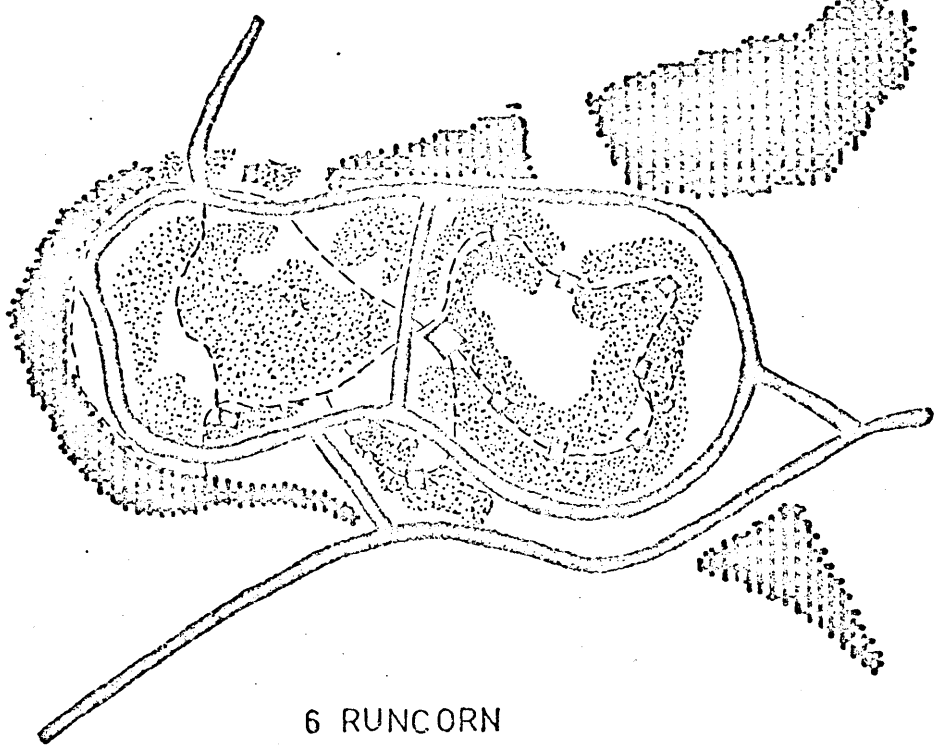
3 NORTHAMPTON
BEDFORD
BLETCHLEY



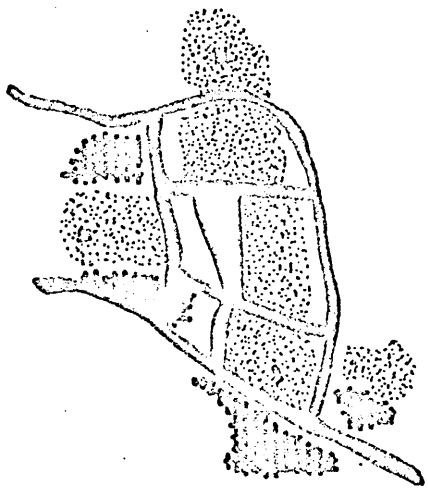
4 HARLOW



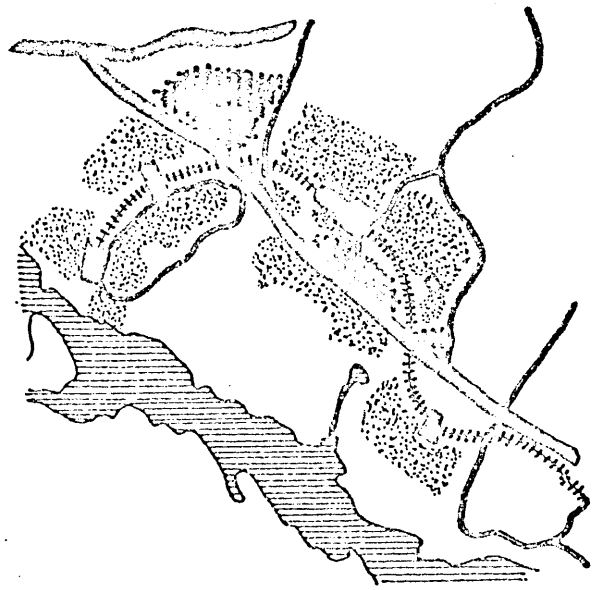
5 CUMBERNAULD



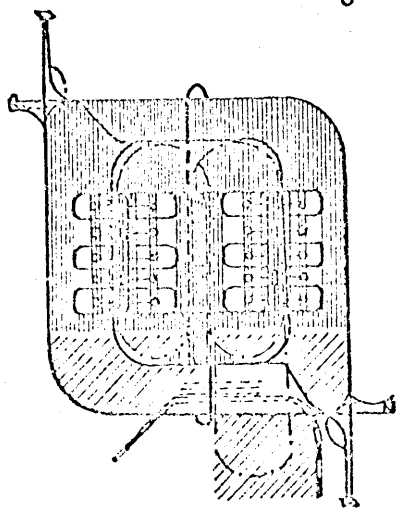
6 RUNCORN



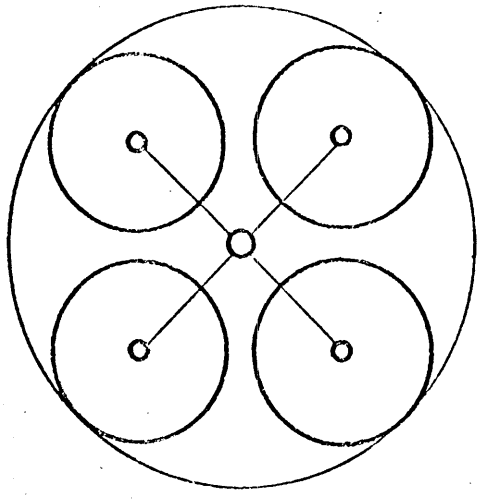
7 SKELMERSDALE



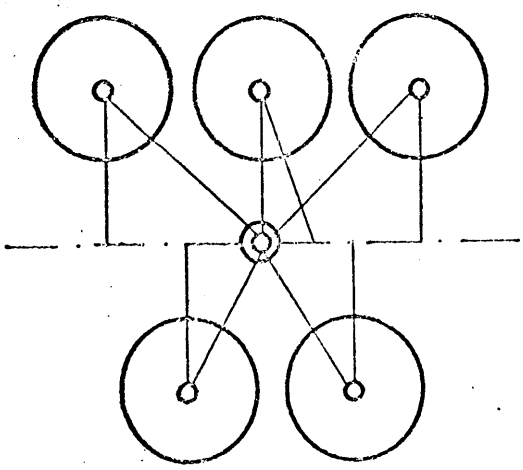
8 VALLINGBY GRUPA



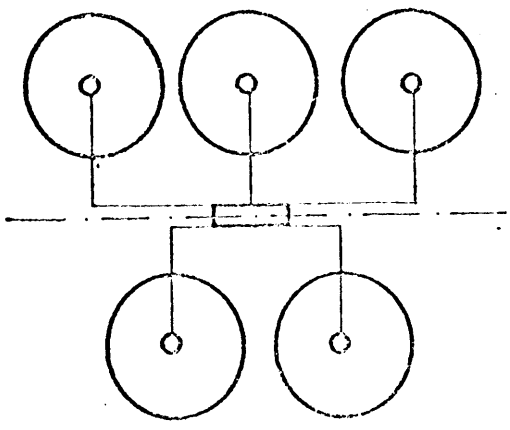
9 · THEORETICAL CITY MODEL



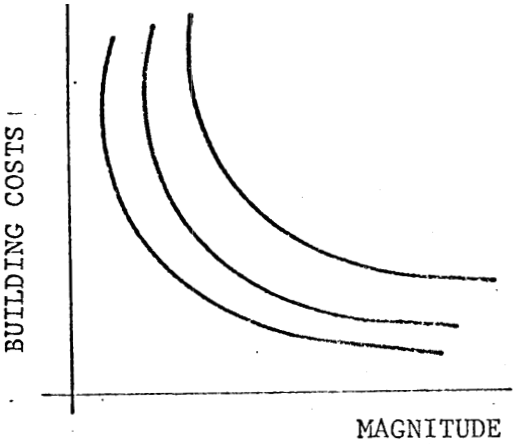
10 CONCENTRIC - CIRCLE RAYON STRUCTURE



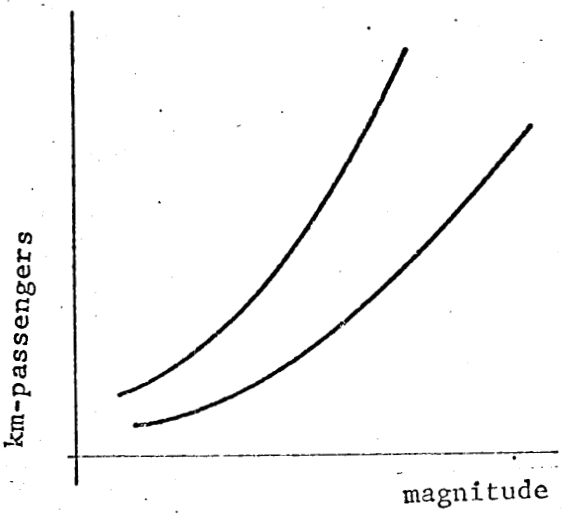
11 LINEAR - RADIAL RAYON STRUCTURE



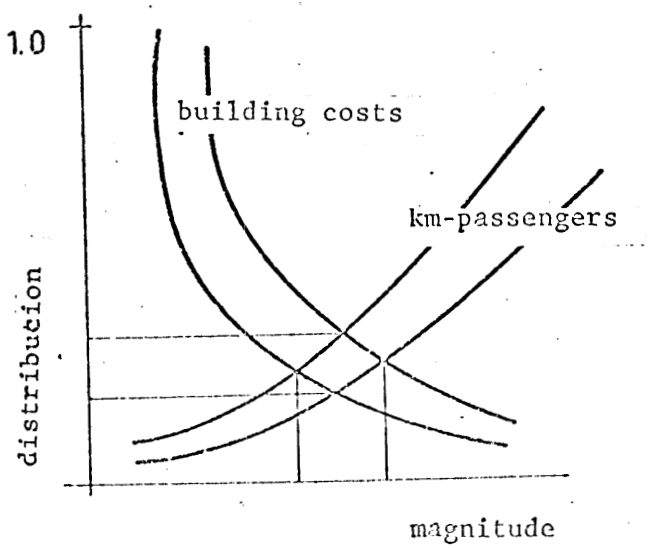
12 LINEAR - TANGENTIAL RAYON STRUCTURE



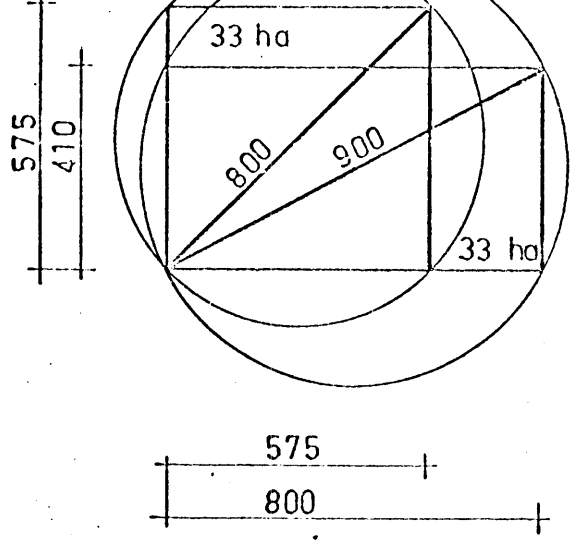
13 SETTLEMENT BUILDING COSTS



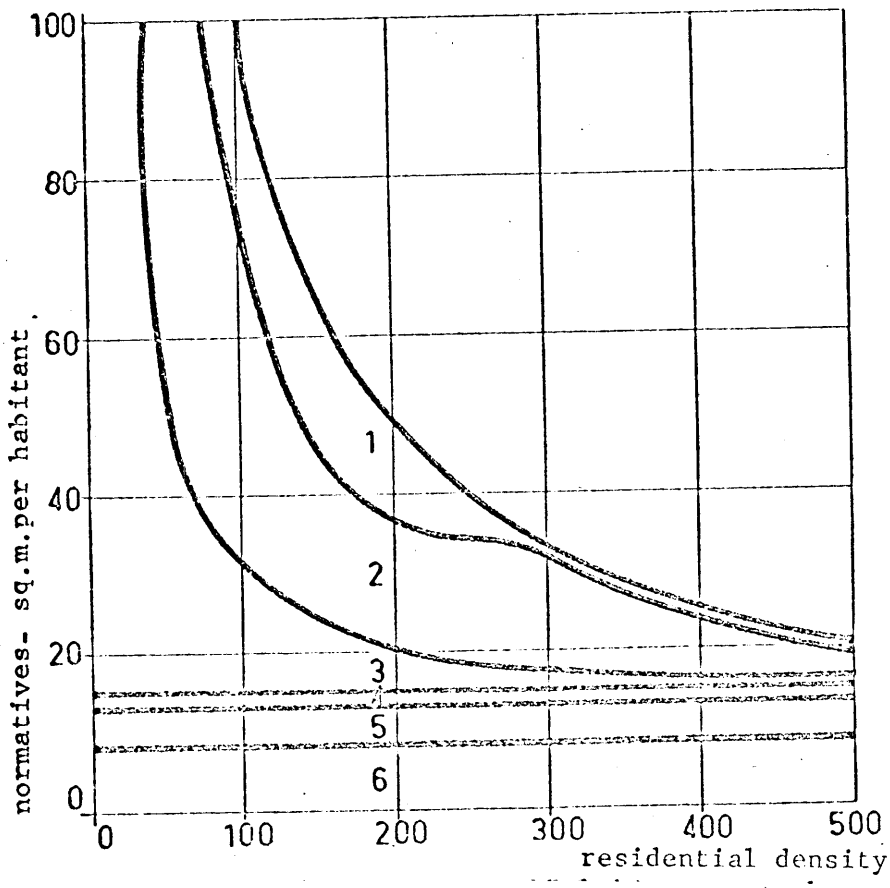
14 DIAGRAM OF THE COMMUNICATION FACTOR (km-passengers)



15 OPTIMALIZATION METHOD OF THE RAYON MAGNITUDE

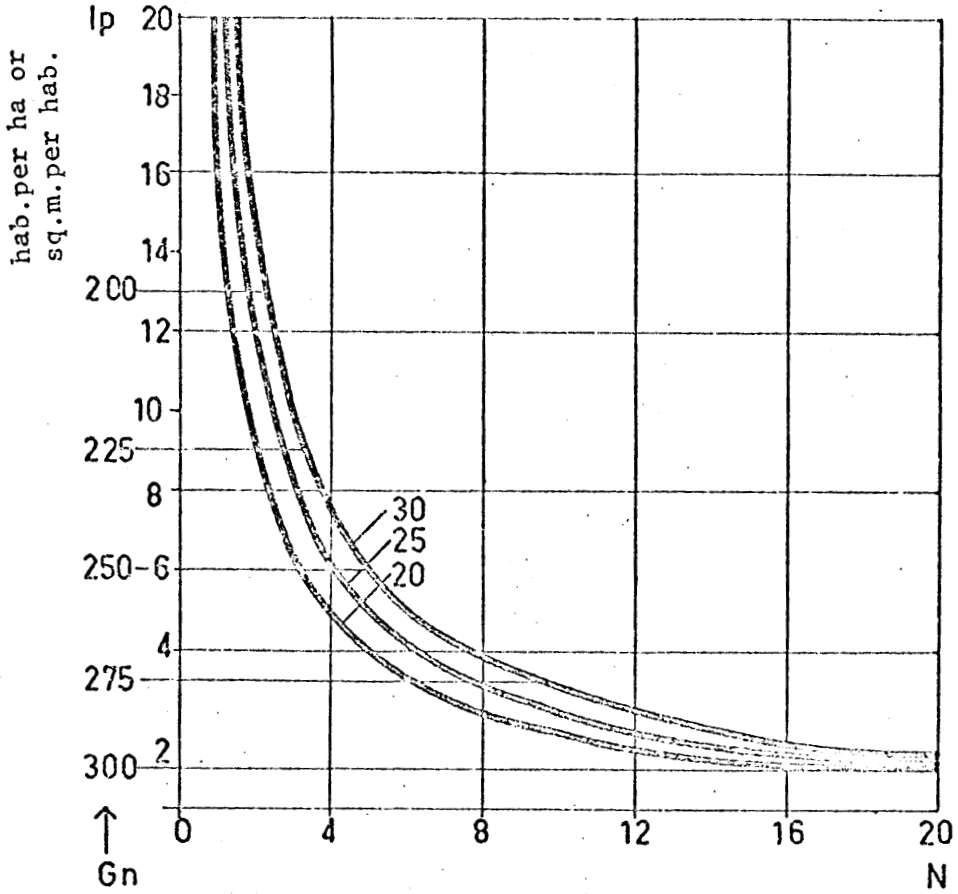


17 NORMATIVES OF THE URBAN COMPLEX IN LOCAL COMMUNITY, DEPENDING ON RESIDENTIAL DENSITY



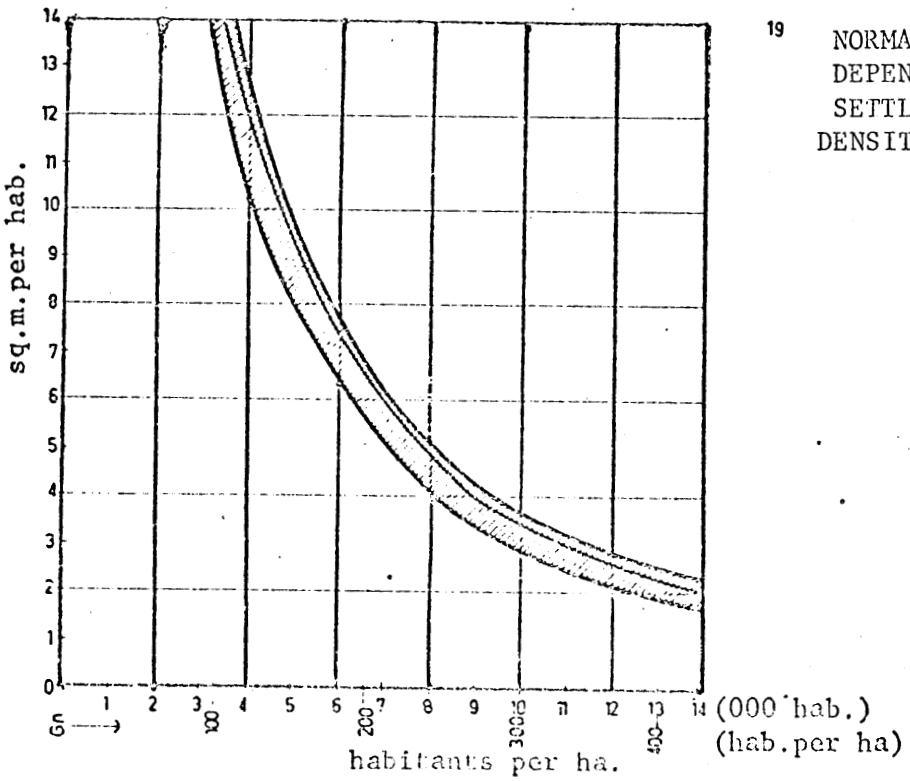
1- under resident. houses
2- open area around res.houses
3- roads
4- parking
5- recreation area
6- services

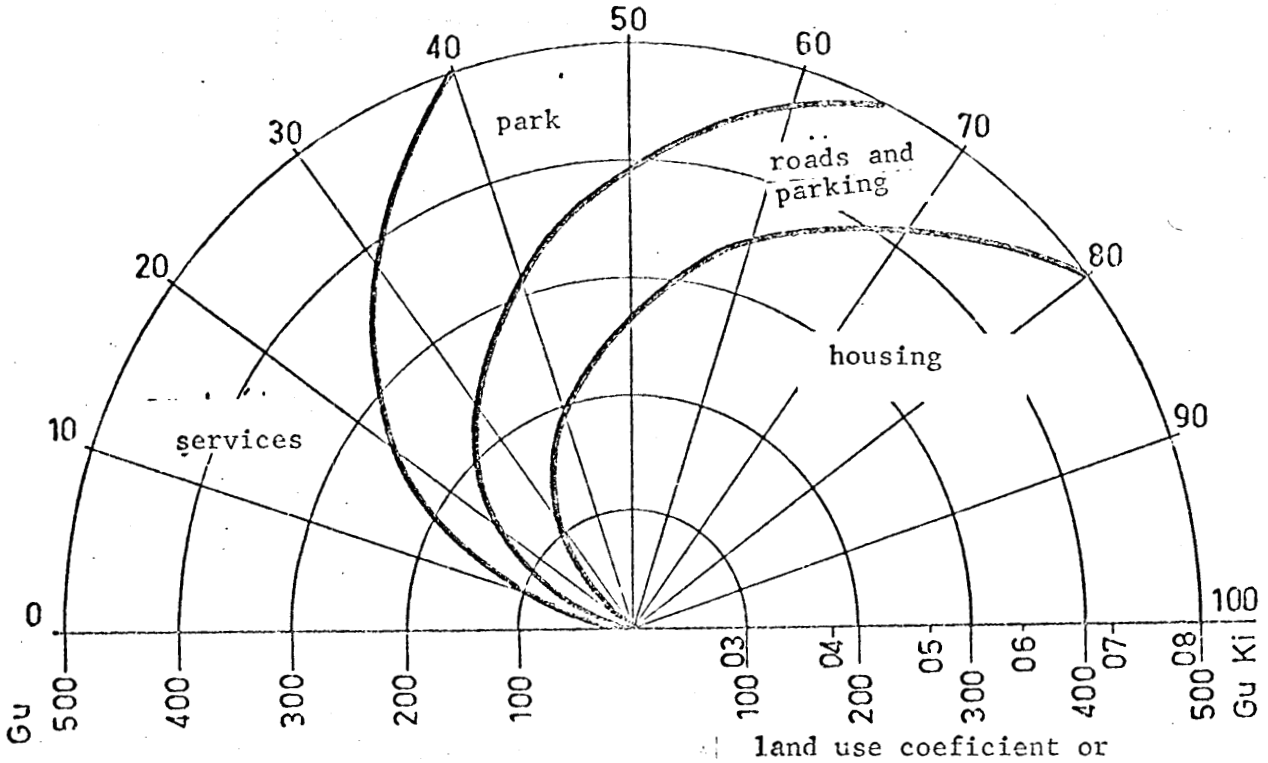
18 SURFACE NORMATIVES OF SETTLEMENTS UNDER RESIDENTIAL HOUSES



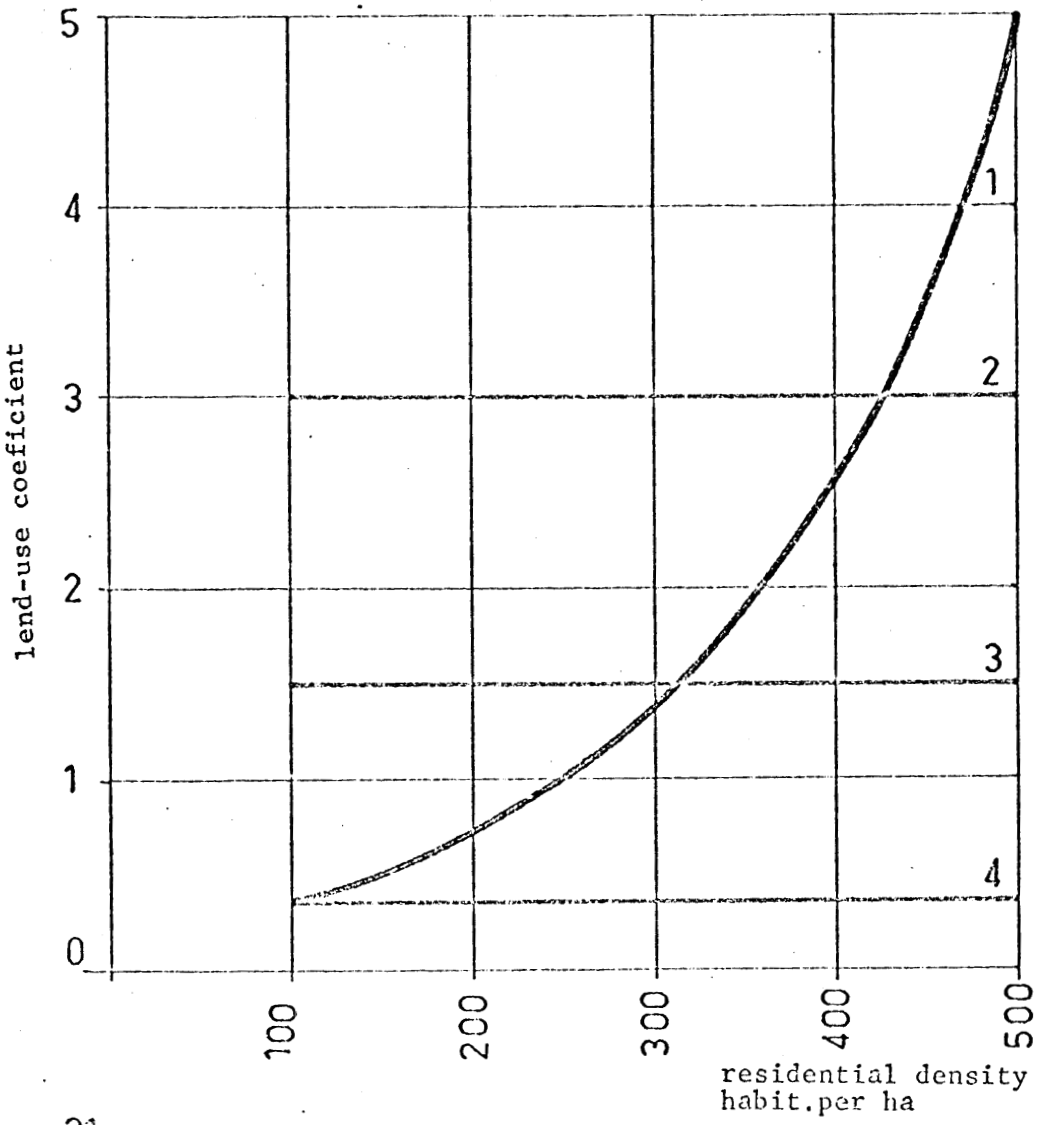
N- number of floors
Ip-gross surface under building
Gn-gross residential density

19 NORMATIVES OF ROAD SURFACE, DEPENDING ON MAGNITUDE OF SETTLEMENT OR RESIDENTIAL DENSITY

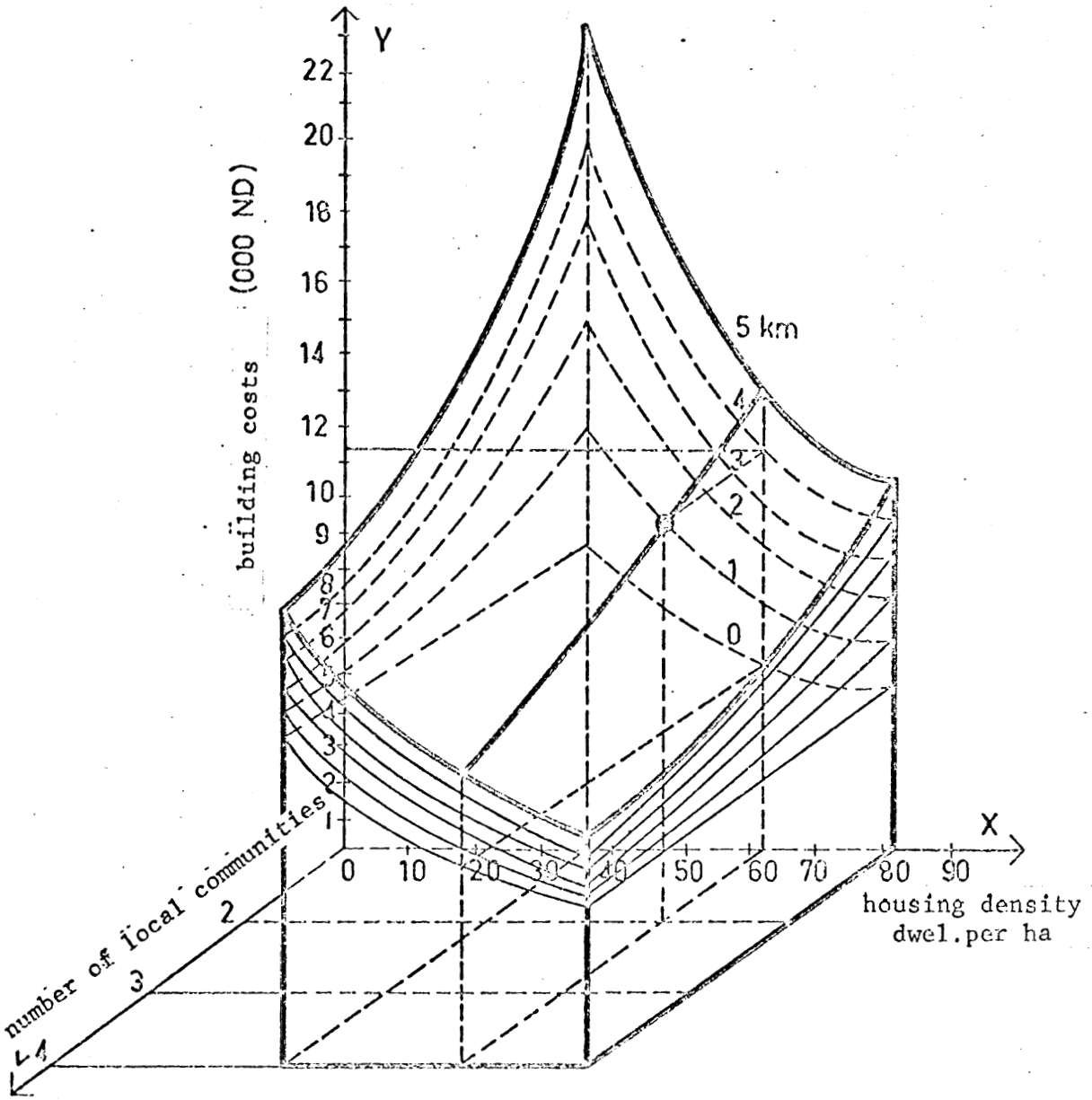




20 NOMOGRAM OF LEND-USE IN A SETTLEMENT (LOCAL COMMUNITY)

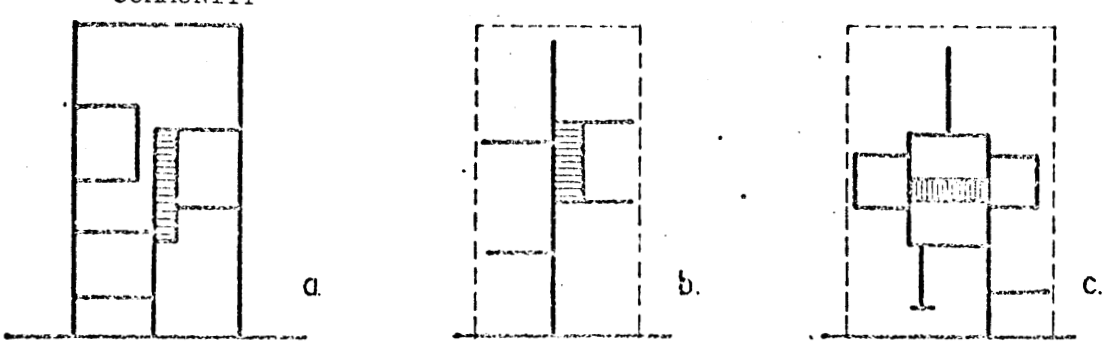


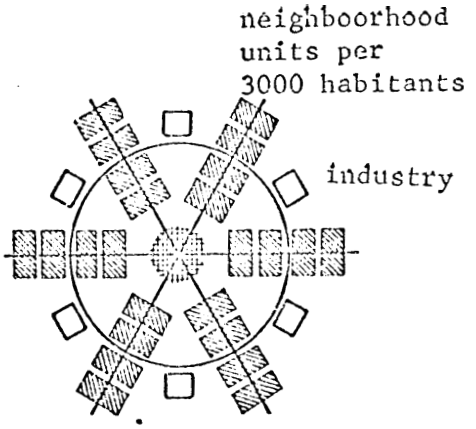
21 LEND - USE COEFICIENT OF RESIDENTIAL HOUSES (1), CARAGES (2), SCHOOLS (3),



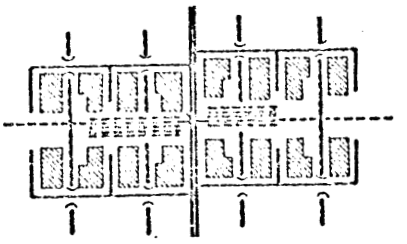
TRAFFIC SYSTEM IN LOCAL COMMUNITY

a/ gravity, b/ dispersive
c/ combined

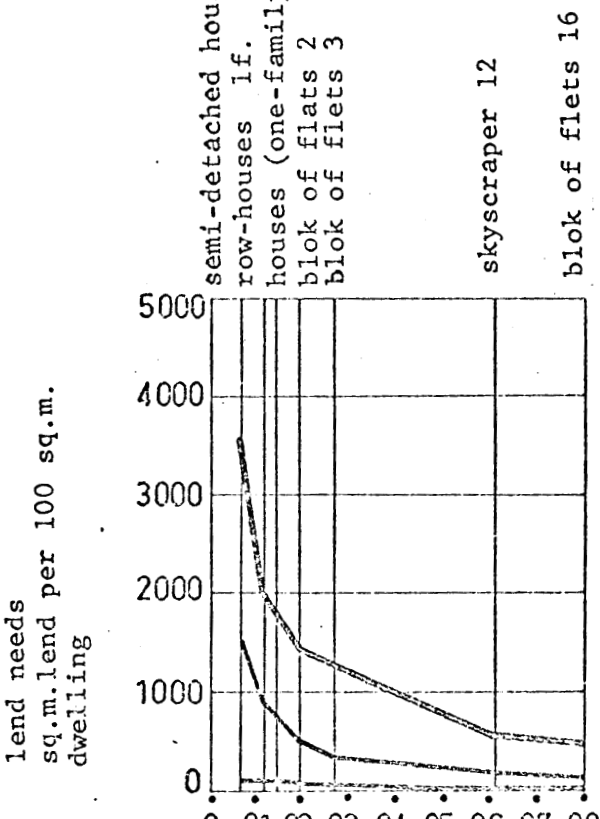




a) 1f.

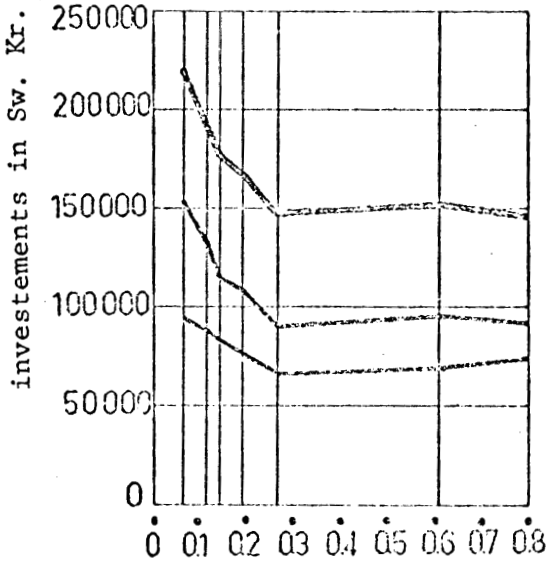


b) THEORETICAL CITY MODEL FOR 75.000 HABITANTS AND MODEL OF NEIGHBOORHOOD UNIT (Sweedish experiences)

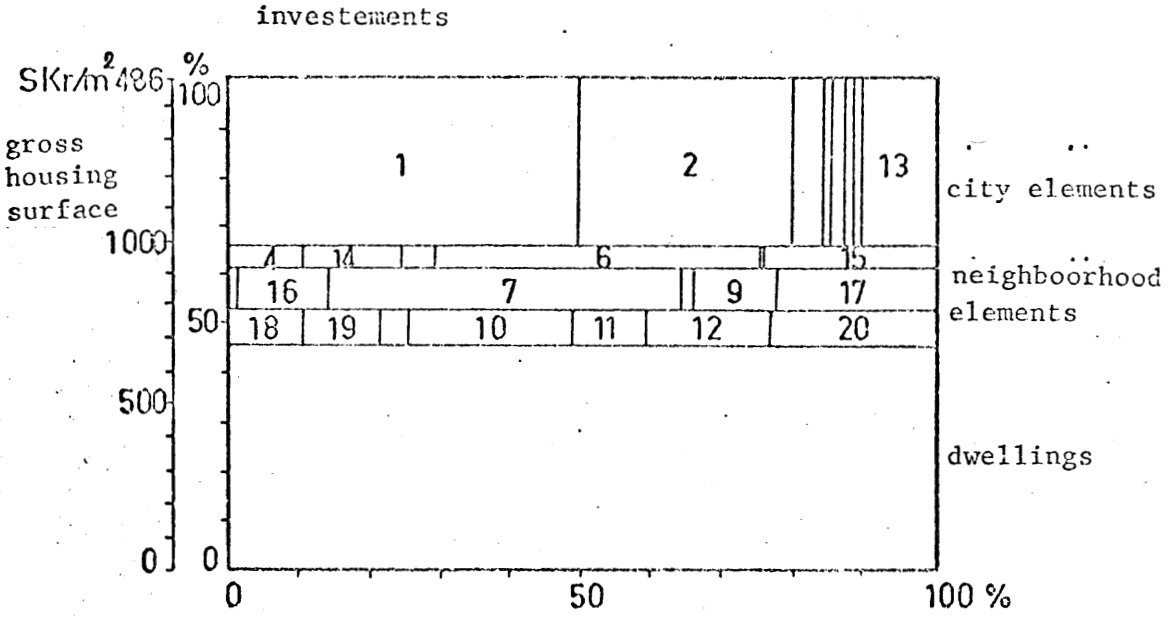


25 LEND NEEDS PER DWELLING FOR DIFFERENT HOUS TIPES

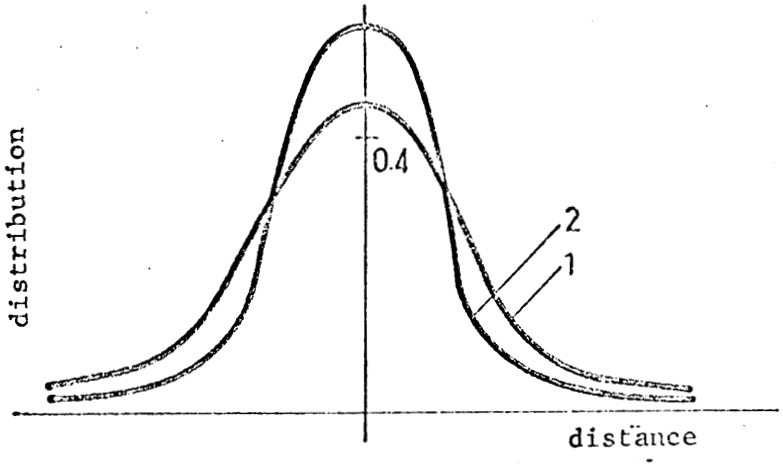
city elements
neighboorhood elements
dwellings
building ratio (built surface per residential are)



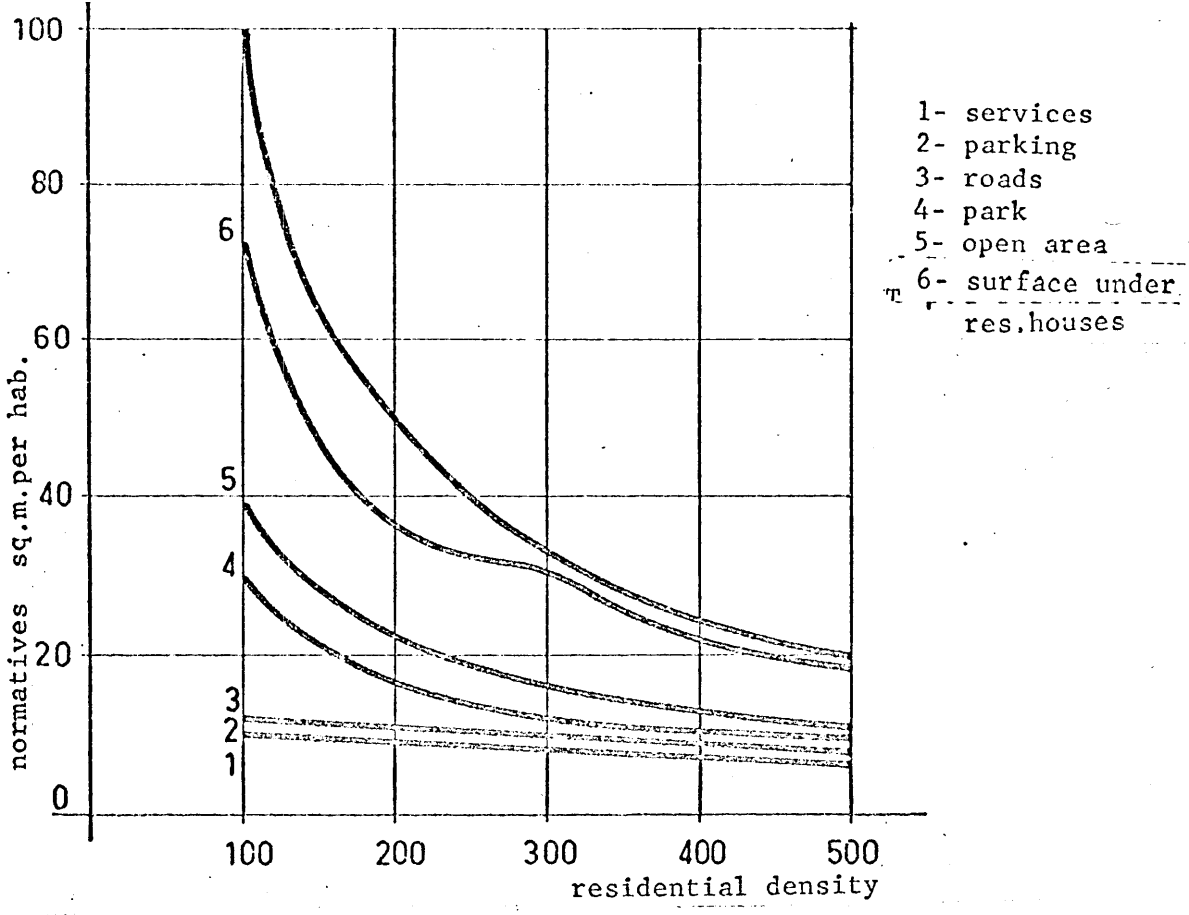
INVESTEMENTS PER DWELLING FOR DIFFERENT HOUSE TYPES



27 INVESTEMENT DISTRIBUTION IN CITY FOR THREE FLOOR HOUSES

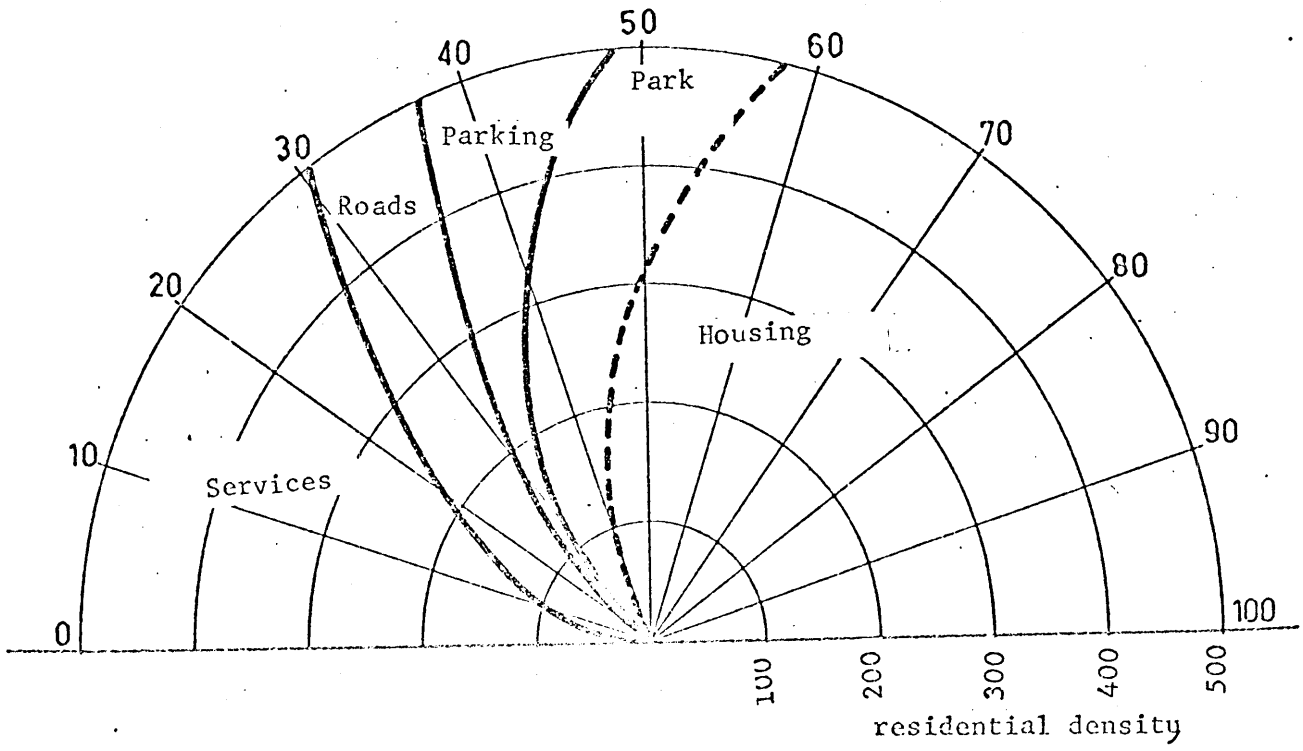


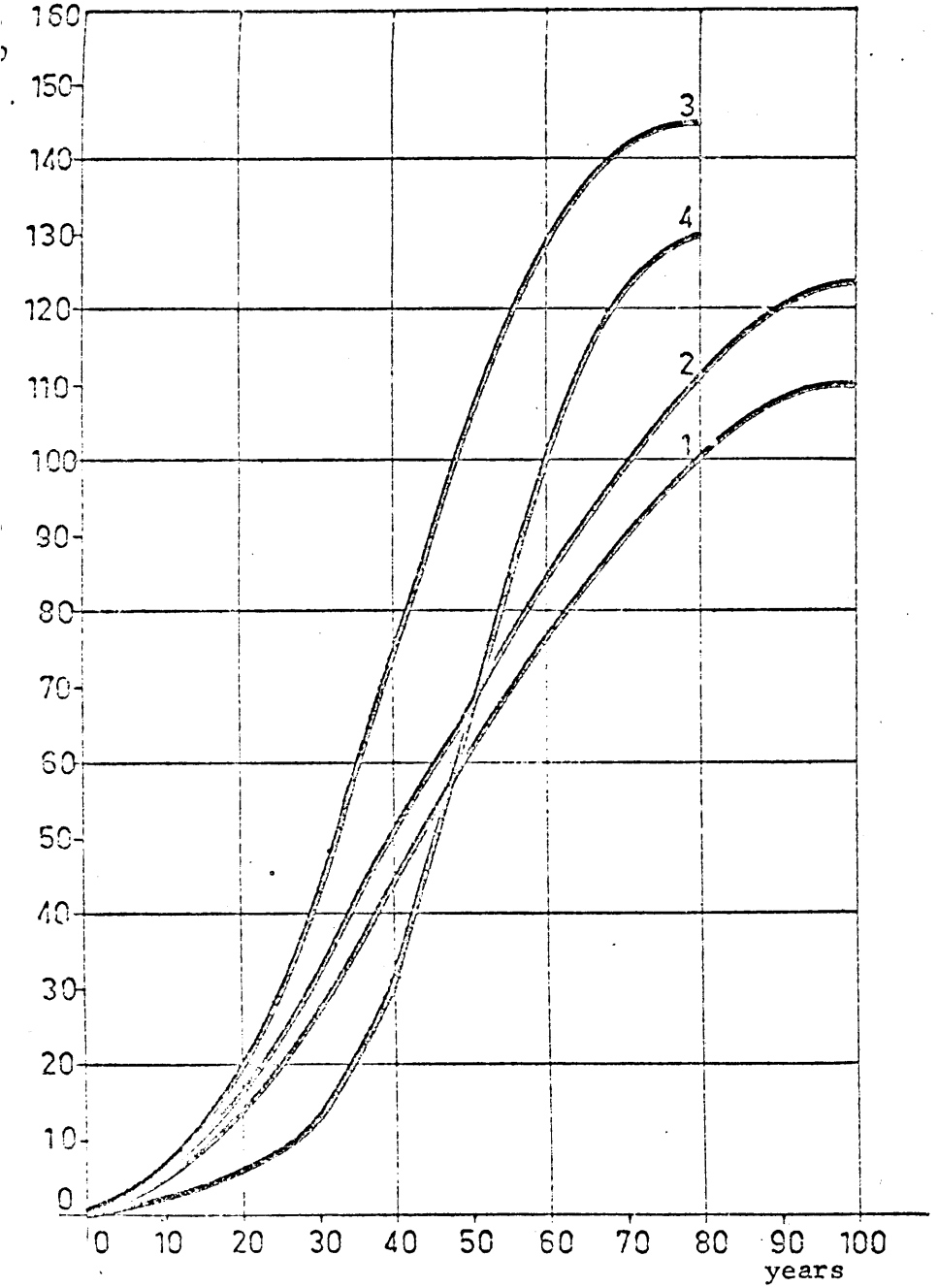
28 PROBABLE RESIDENTIAL DENSITY IN A CITY



29 | NORMATIVES OF SETTLEMENT SURFACE - RECONSTRUCTION

30 SURFACE STRUCTURE IN A SETTLEMENT - HOUSING RECONSTRUCTION

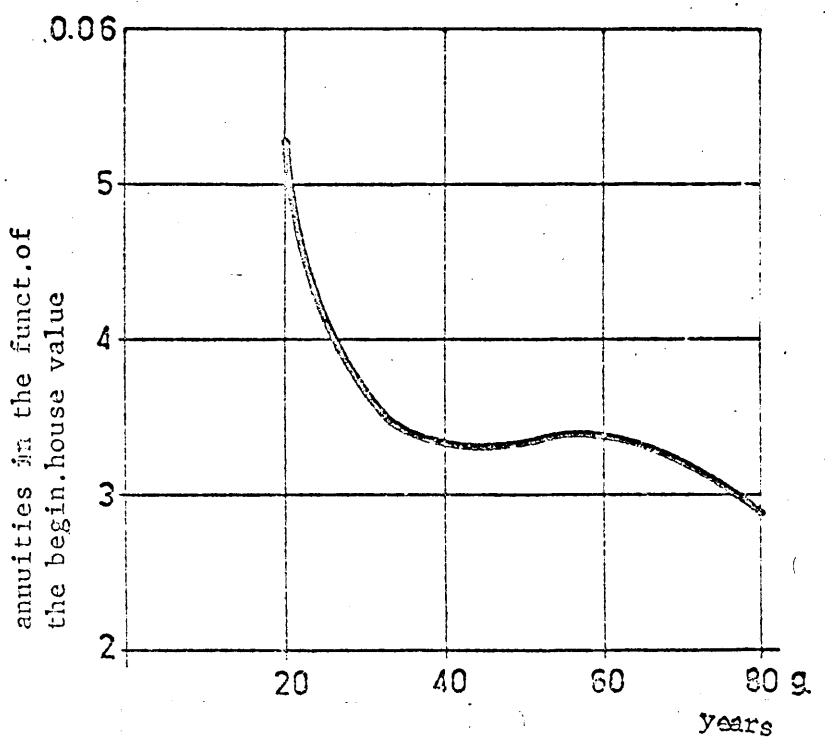


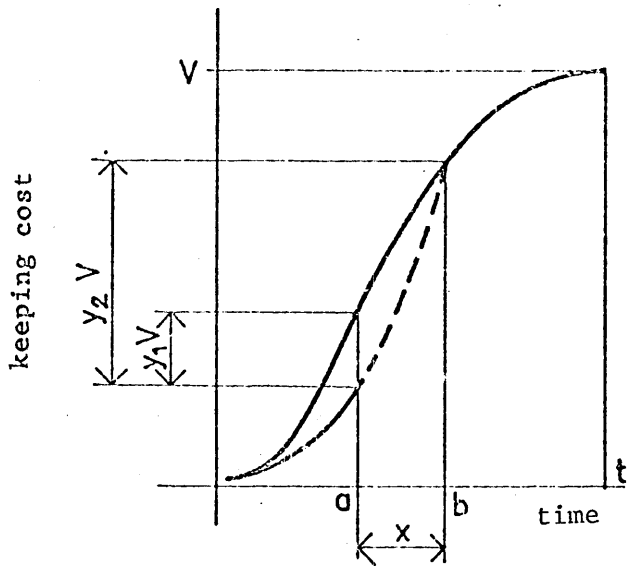


3 INVESTIMENT COSTS OF RESIDENTIAL HOUSE KEEPING AS THE PERCENTAGE OF THE BEGINING HOUSE VALUE

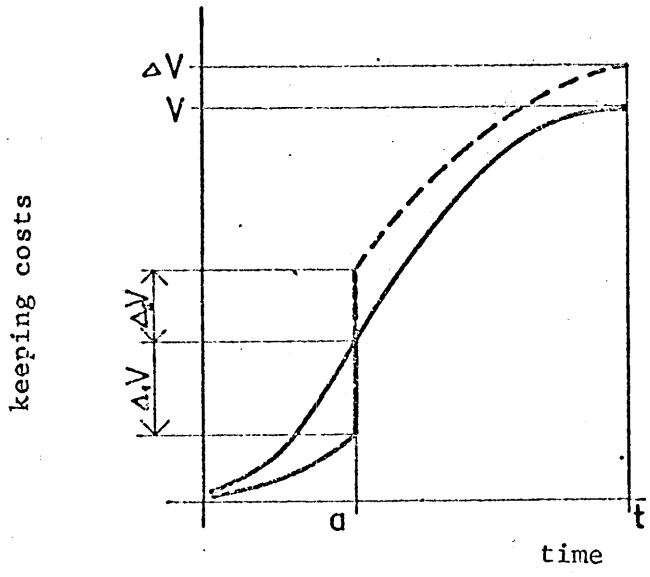
1-Poland, 2-CSR, 3-Sweden
4- experimental function

32 ANNUITIES FOR THEORETICAL CASE OF HOUSE KEEPING

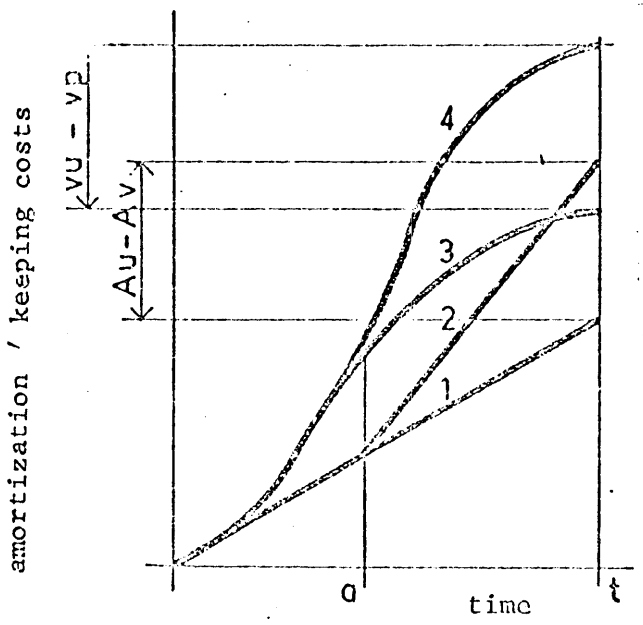




INVESTEMENT SPEED IN ORDER HOUSES TO BE BROUGHT ON THE STANDARD USAGE LEVEL



INVESTEMENT SPEED IN ORDER HOUSES HOUSES TO BE BROUGHT ON THE HIGHER STANDARD LEVEL



AMORTIZATION BEFORE (1) AND AFTER (2) AND KEEPING COSTS, BEFORE (3) AND AFTER (4) MODERNIZATION OF HOUSING STOCK

5th Part: SYNTHESIS AND CONCLUSIONS

Successful housing planning is, in great measure, conditioned by positive town planning legislation, the global country housing situation, and urban development on the whole.

Present town-planning legislation (Yugoslav as well as others) is mainly incomplete in view of housing planning. First, housing planning should be treated in the context of city urban development and its metropolitan area. Second, it should be particularly treated as a function and economic activity due to its special importance for the total urban development of a city. As for the level of solving, housing should synchronizely be planned on metropolis, city and settlement levels, implying adequate plans and its contents. The planning phase and design phase should be separated, and as a rule, the former should imply application of analytic methods, quantification and optimalization.

Tendencies of developing urbanization process in Yugoslavia indicate two characteristic phenomena: relatively slow satisfying of global housing needs and fast population growth of large and small cities. Keeping in mind that the urbanization process will continue at a high speed, it should be redirected towards average cities. Thus, the concept of urban implosion would be realized, differing from the present urban explosion. The first shape of urbanization responds more to future needs of urban development, especially in developong countries, because it limits negative implications which are a result of the explosion of large cities. Such urbanization makes possible faster and more proportional urban development in metropolitan areas or in the space between large cities. This occurs not only in the space sense but in the economic sense as well. Such development should be planned on the basis of urban systems formed in metropolitan areas as a complex of the primary and secondary centers and eventually even tertiary centers. Successful solving of the housing situation in the context of urbanization would imply synchronization of social-economic and technical development on country and regional levels; that is, urban problems development should be solved in a comprehensive way, according to needs and possibilities, keeping in mind present and future development of a country in the whole. Tendencies of national income increasing, as well as (unreal) housing building costs increasing, indicate the need for acceleration of the tempo of housing building. Due to urban structure changes in many cities, this would be actual (real) in view of qualitative solving of housing demands.

City planning should imply investigation of potential housing needs on metropolitan and city levels, depending on the degree of development concerning housing shortage, quantitative, and qualitative demands. How, in what way, and especially in what period housing problems will be solved, depends on the concrete situation of every town. Manifested tendencies of housing development situations should be used as the basis of housing planning. Circumstances and development of economic and social powers will influence developing flows of the housing situation in a quantitative and qualitative sense.

Observation of housing in the context of urbanization process indicates the cyclic character of urban development, and it means periodical exchanging of housing demands and its elimination. The stochastical rule of urbanization process, determined by housing needs development, indicates that the long range making decision may be possible and improved in view of the precision and the reliability.

A relative regularity of the urbanization process development, it seems to me, would have to be established for every town, but it is not exclusively possible to establish similar or approximate parameters for definite city kinds and types. Thus, regional and country planning would be made considerably easy.

Establishing of urban policy and particularly of city housing policy should be based on the following analysis of the developing housing process, in macro and micro dimensions.

On the first hand, influences and relations of housing determinants in the metropolitan area should be investigated because the housing situation development in the city is in great measure dependent on a metropolitan situation. The investigation method implys, in fact, establishing of metropolitan gravity influence in its wider area, depending on its basic determinant (population), as well as some non-basic determinants (residential and non-residential stocks, communication, etc.). On the basis of distribution probability, as well as on the basis of the relation between basic and nonbasic determinants, it would be possible to conclude respective forecasting of housing urban development and future needs from the quantity and quality of the metropolitanization process.

Developing housing process in a city should be followed in a dynamical sense, and it would be able to expect changes to behave after certain stochastical laws. On the basis of several

indicators, such as residential density, building density and apartment occupancy, and also on the basis of the correlation between housing standards and social characteristics, it would be possible to establish the agreement of needs and possibilities. Proposed methods imply quantification models of measuring of this agreement. When residential settlements are in the design phase or realized, they can be tested (valuated) by adequated methods and eventually its urban characteristics will be corrected. This task may be solved in a simplified sense, on the basis of correlation of four parameters: open surface around houses, the participation of residential part in total settlement area, land use coefficient, and average floor number of residential houses. When conditions are given in advance or criteria and normatives are established, then it would be possible to establish the optimal relations of these parameters. Declinations of given parameters related to optimal values will discover the quality of solutions.

There is a similar purpose of the valuation method of settlement building costs. Thus, when a settlement is planned or built, it would be possible to test in what measure it is objective and afterwards be corrected. This task first implys the cost rank which is based on the established dependence between unit cost and building density and settlement magnitude; second, it implys the establishing of optimal influence limits of building density and settlement magnitude; and third, establishing of extreme and optimal costs after and in advance of defined building criteria. By statistic analysis, it would be possible to establish the rate of deviation and the degree of dependence of parameters influencing building cost.

Housing planning should be contained in comprehensive planning, that means firstly on the metropolitan level. Planning process should imply five phases: 1) goals, 2) projecting of wishes and possibilities, 3) prediction and forecasting, 4) choice of alternatives, 5) implementation. Structure of plan should imply four steps, in fact four kinds of plans: 1) long-range (30-40 years), 2) developing (10-15 years), 3) program of development (3-5 years), 4) budget plan (1 year).

In the housing aspect, sectorial analysis of housing is very important in the comprehensive planning. It should contain analysis of structure, distribution and synthesis. It should also be dynamic and be done on metropolitan and city levels. Its purpose is establishing a global housing situation as well as differential situations inside of observed units (block and

residential commune). On the basis of housing sectorial analysis, it should be necessary to establish goals and wishes of housing policy of urban development.

The next phase of planning is quantification of a metropolitanization process, which has as its aim the establishment of stochastical rules of developing processes. Considering that this analysis should be dynamical, so that changes in the future can be forecasted, it would be very important as a decision-making process if this job is to be perpetual. The method, previously described, implying established of the gravity influence of a metropolis, was tested by the example of Belgrade. It shows that the metropolitan gravity influence changes after the law of Poisson's distribution probability. It also indicates the reality of the thesis concerning determination of the total urban growth on the basis of the correlation of the integrals, probability of population growth, and residential (building) density growth. Establishing of metropolitanization process tendencies should serve as the first step in determining a future urban system. Judging by the developing metropolitanization process of Belgrade, as well as keeping in mind urbanization flows and its speed and tempo in Yugoslavia, it would be possible to establish very certainly that a ring system of urbanization in a metropolitan area has a suitable shape in terms of forming an urban system (one primary city and more satelite towns, average or small ones). Observing other kinds and types of metropolitan space structure, we concluded that such a ring structure, with regularly disposed secondary centers around the primary center, has advantages over other types of gravity structures and all dispersion ones. The advantage consists not only in space sense, because of distance and communication and primary center disencumbrances of functions, than on the first hand because of possibility of establishing of urban equilibrium (a kind of stable state) implying linked demographic, economic and functional balance. The model, developed in this sense is established by some principles of mechanics and the theory of probability.

Solution of the relation between the primary and secondary centers in this task implys establishment in advance of the optimal population distribution in a metropolitan area. The algoritam is based on the finding of the minimal volume integral, formed by the probability distribution of population function and the probability distribution of trip function.

When metropolitan housing determinants are defined, they should approach general planning on the city level. This means that principles, criteria normatives, and standards should be defined in advance. Space concept of housing organization, for instance stages units, should also be defined in advance.

Judging by experiences of new towns in Great Britain and Sweden, we would not be able to say that the neighborhood unit concept is generally accepted and developed. We mean it is more the consequence of an inadequate realization than a poverty of this concept. In further urban development, meanwhile, the residential commune concept based on the neighborhood unit will be actual and further useful, not only in a sociological sense but also in a technic-economic sense. General city planning and housing in this need larger units such as quarters and rayons which form residential zones defined in view of magnitude and structure. In a quantitative sense, this problem can be solved on the basis of the relation of building cost and communication factor, differently changing in residential density and magnitude functions.

Settlement planning (residential commune), which responds to phases of making regulative and idea urban plans, is very important in the housing quality aspect. It should be based on established normatives and criteria. Keeping in mind that urban components of settlement can be constant and variable, that is, the unit surface (or habitant) stays the same or changes, then settlement urban structures change depending on residential density changes. With density increase, the participation of nonresidential part growths and reversely with density decline, the residential part growths.

Settlement and city buildings costs are important factors in the decision-making process. Meanwhile, this domain is undesirably unexplored. After Swedish experiences, however, the part of residential zones costs in total city investments amounts to 60 percent. The urban concept way of infrastructure solution and traffic system can considerably influence cost changes. Such parameters should be more detailedly explored so that on this basis criteria and measure of convenience for settlements of different urban structures and types, as well as zones and cities, will be defined.

Analysis of conditions and possibilities of housing reconstruction also represents an important planning phase. On the

basis of global and detailed examination of reconstruction conditions it would be possible to make a decision about volume and housing quality in new zones on the whole. This analysis should imply investigation of three efficencies: space (land occupancy), traffic (population distribution), economic (land use). This analysis should be based on criteria and normatives defined in advance, in view of magnitude and settlement urban structure. At last, in the extent of reconstruction conditions, it would be necessary to establish the optimal period of exchange of new housing stock which is planned. The purpose of this investigation is establishing of an economically suitable period of exchange, according to technic-technological conditions of house structure given in advance which would also be suitable in the sociological aspect. After present technology and economic development tendencies, shortening of the amortization period by half (about 45 years), it seems to me, is quite suitable. In a technical and economical sense it would be possible, and at the same time it would mean that house structures should be conditioned in advance according to urban development needs. It should not be allowed that planning and design of houses be quite open, and predominantly by a technical approach.