FORMULATION AND SIMULATION OF A GROWTH STRATEGY FOR THE
DEVELOPMENT OF FINCA LA MARINA IN SAN JUAN, PUERTO RICO.

by

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Abstract:

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In the development of a large residential area, the growth strategy used to implement the master plan is as important as the master plan itself.

A survey is made of five existing New Towns or city expansions to analyse their growth strategies, before formulating general conclusions about growth strategies for large residential developments. These conclusions are then applied to the Puerto Rican site, Finca La Marina, as an aid in defining the goals for the growth strategy of the development. An account is given of the simulation of Finca La Marina’s growth with the help of a computer aided design system named "IMAGE". After the second phase of development, the use of the IMAGE system was interrupted and the simulation was continued by traditional design methods. The results derived from IMAGE were translated into conventional graphics.

Conclusions are drawn about the growth strategy for Finca La Marina and the value of the IMAGE system in the particular case and for general design purposes.

A carefully annotated bibliography concludes the thesis.

Thesis Supervisor: Horacio CAMINOS

Title: Professor of Architecture.
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This paper was typed with care and perfection by Madeleine LEULLIER.
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During the summer of 1970 the staff and the students of the Master's Class "Urban Settlement Design in Developing Countries" in the Department of Architecture of the Massachusetts Institute of Technology were asked to be the informal consultants for C. R. U. V., the Urban Renewal and Housing Administration of Puerto Rico in the development of the site "Finca La Marina". In September of the same year, the author began to participate in a research project, the purpose of which was to develop design methods and to apply the findings to the formulation of a computer-aided design system named "Image".

The "Image" system was to be used in testing the design criteria of a development and in the production of alternative designs for an actual site. It was hoped to compare the design produced by "Image" and the designs produced by the other students in the Master's Class who were using traditional design approaches. However, the study was later limited to growth strategies of the site "Finca La Marina" utilizing the "Image" program to simulate growth and produce alternatives.
We will assume in this thesis that housing, schools, open spaces, means of communication, commercial and social facilities are essential for human development.

We will call an increase in these amenities "growth", and any growth without the intervention of a government institution "natural growth". Growth is defined by the object that is being augmented, and by the size and time span of the expansion.

We will assume that government institutions are needed to help provide and control the provision of the amenities listed above. We will define "growth strategy" as a set of guidelines used by a government institution for a step-wise implementation of a plan for the provision of housing, schools, open space, means of communication, and commercial and social facilities. A step-wise implementation is used when there is no means or need of an instant development.

These concepts are quite different from those used by Chapin, Weiss, or Donnelly (ref. AG, BE, and AM). The urban growth they speak of is mainly left to the forces of the free market, and the growth strategies they mention are techniques to steer this erratic growth towards a "better product".
From opinions and information gathered during informal contact with C. R. U. V. officials in Puerto Rico, and in Finnish, Polish, and British New Towns, it seemed obvious that a growth strategy was at least as important as a site plan, since one of the chief problems reported in the expanding New Towns was the difficulty of keeping all of the functions of the development working in the prescribed relationship at every stage of the development.

Because my purpose was to formulate a growth strategy for the Finca La Marina site, I thought it necessary to first investigate the information which already existed on the subject.
During the period of research, the lack of information on growth strategies and the reasons for it soon became apparent.

When a plan is made for a development of 20,000 to 60,000 people, it becomes a political issue very quickly. Many factions will try to protect their own interests, and some may even try to monopolize the benefits of the project. The developing agency will try to protect itself as much as possible from outside pressures and criticism, but the agency also wants to be able to change its course of action if public criticism becomes too great to ignore, for example, or if the development becomes financially unfeasible in its present form. For these reasons, plans showing how a development will grow over a period of time are often published, but the reasoning that led to the particular plan is seldom documented. The limited amount of information that was found is reported on the following pages.
THE PHYSICAL GROWTH STRATEGIES USED IN THE PLANNING OF NEW TOWN SETTLEMENTS IN SWEDEN, AND IN PARTICULAR, VÄLLINGBY

The growth strategy used for New Settlements in Sweden and especially around Stockholm is the most lucid and convincing found.

The first stage consists in the building of a subway station connecting the site with the rest of the metropolitan area. The location of this subway station is said to be the result of thorough surveying of the site and the housing demand, and of the planning of the new settlement.

The second stage was built both simultaneously with, and immediately after the first stage, and is a concentrated development of the area in the immediate neighbourhood or the station, the aim being to provide accommodation and employment as quickly as possible at the centre which is to be established there. From the beginning, the structure of the core of the new settlement is set. The first stage is as self-contained as its size permits. Medium-high density, high-rise condominiums are built, but also employment for 25% of the resident population. Enough schools are added as soon as the population is large enough to support them at minimum occupancy.

In the later stages, dwellings are built radially out from the core. As they are built further away from the core, the density and the building height become lower, with the outer layer
consisting of detached single family homes.

Välingby grew to a size of 23,000, but it has an oversized centre because it was planned as a central shopping, amusement and employment area for 60,000 additional people grouped in surrounding developments. The goal was to make a complete town section from the beginning - not the usual dormitory suburb, but a microcosm of a city.

The information displayed on figures 1 and 2 is not believed to be entirely accurate (ref. BD, p. 68 and ref. AC, p. 172-183).
VÄLLINGBY, STOCKHOLM

**Legend:**
- HOUSING, LOW DENSITY
- HOUSING, HIGH DENSITY
- CENTRAL AREA
- INDUSTRY
- LAKE OR RIVER
- GREEN - OPEN SPACE
- PRIMARY SCHOOL
- SECONDARY SCHOOL
- NEW ROAD
- EXISTING ROAD
- RAILROAD

**First Phase Line Delimiting the Landuses Created During the Period Described in This Drawing**

**First Phase**
VÄLLINGBY, STOCKHOLM

Fig. 2

HOUSING, LOW DENSITY
HOUSING, HIGH DENSITY
CENTRAL AREA
INDUSTRY
LAKE OR RIVER
GREEN - OPEN SPACE
PRIMARY SCHOOL
SECONDARY SCHOOL
NEW ROAD
EXISTING ROAD
RAILROAD
LINE DELIMITING THE LANDUSES CREATED DURING THE PERIOD DESCRIBED IN THIS DRAWING

SECOND PHASE
Radburn Garden City is still considered as a monument of American town planning. Its concept of segregation of pedestrian and vehicular traffic had a great influence on later town plans. Even now, whenever cars are allowed to penetrate only a subdivision through cul-de-sac roads enclosed by the backyards of dwellings, and when all the front yards of the dwellings face pedestrian walks or open green spaces, this subdivision is said to be planned according to the Radburn System. The planners of Radburn Garden City, Clarence S. Stein and Henry Wright, speak of the "Radburn Idea" as if it was their idea. It can be argued that Frederick Law Olmsted and Calvert Vaux first planned to segregate different modes of traffic in their plan for Central Park (ref. BB, pp. 16 and 44). On the other hand, it is certain that Louis de Soissons used the Radburn Idea long before Radburn Garden City came to existence in a development in London. Although Radburn had the name of a garden city and was planned to house 25,000 people, it never was planned as a garden city if one accepts the definition of Ebenezer Howard as Lewis Mumford relates it: "The Garden City, as Howard defined it is not a suburb but the antithesis of a suburb: not a more rural retreat, but a more integrated foundation for an effective urban life." (ref. AO, p. 35).

No place of employment except a small building materials trade was planned on the site, and no shopping or recreation facilities outside of a swimming pool. The Garden City never
reached the 25,000 target and the final number is omitted in Clarence Stein's account of the growth of the City (ref. BB, pp. 57-67).

Nowhere in the text does Clarence Stein include material about the physical growth strategy, nor does he explain why the first houses were built on the west side of the site. It seems clear though that they were built there because that was the closest to the railroad station. But this makes the more outlying neighbourhoods less attractive than the ones first developed. In the case of Välingby, the disadvantage of living further away from the station was compensated for by the provision of more private open space around the dwellings. In Radburn all the dwellings are similar and differ only by the convenience of their location.

Only Lewis Mumford writes about the timing of the provision of services during the growth of the Garden City, in his introduction of Clarence Stein's book: "Their (Stein's and Wright's) growing attention to the promotion of social life, through the timely provision of schools, shopping centres, community meeting rooms, informal outdoor meeting places, and, even in Radburn a swimming pool, distinguishes the work here presented from the more rigorous but somewhat less genial schemes that were current in Europe, particularly in Germany, during the same period, a moment when the tenant's "minimum of existence" seemed to represent the modern architects' "maximum of desire"."
(ref. BB, p. 17).

The drawing on figure 3 was made principally to show the first phase, since the second phase was never completed.
RADBURN, NEW JERSEY

FIRST PHASE

SECOND PHASE

HOUSING, LOW DENSITY
HOUSING, HIGH DENSITY
CENTRAL AREA
INDUSTRY
LAKE OR RIVER
GREEN - OPEN SPACE
PRIMARY SCHOOL
SECONDARY SCHOOL
NEW ROAD
EXISTING ROAD
RAILROAD

LINE DELIMITING THE LANDUSES CREATED DURING THE PERIOD DESCRIBED IN THIS DRAWING
The London County Council made plans for a New Town in Hook, Hampshire but the town was never built because of a change in policy of the British Government. When the Conservatives came to power in 1952 they decided to end the planning and building of New Towns and instead started the "Expanding Towns Program" (ref. AY, p. 7). Still, the plan for Hook New Town was the model for the New Towns of the Second Generation of which the most well-known is Cumbernauld. The New Towns of the First Generation are of the type represented by Harlow and those of the Third of the type represented by Redditch. (For a comparison of the three different generations, see ref. BD, p. 68 and figures 27, 28, 29.)

Why was it planned to start the building of Hook on the northern end of the site?

a) The residential areas could be built between the northern end of the central area and the northern industrial area, ensuring a compact town from the beginning.

b) Existing roads were converging on existing shopping facilities in a village on the north-east flank of the site. The areas that appear not to be developed during the first five years of the development of New Town Hook are the existing villages (see figure 4).

c) An existing bus route would serve residents and industry until the town was large enough to support its own service.
d) The railway station is 3 kilometers away. The aim was to discourage commuting by train.

e) The town's sewage could follow the natural fall of the ground in the north. Initial capital investment for a sewer main could be reduced.

f) There were gravel pits at the northeast quadrant of the site. The greatest bulk of building materials used in the construction of asphalt roads and concrete buildings is gravel. A large part of the cost of gravel comes from transportation from the quarry to the building site. The shorter the distance between them, the cheaper the gravel (see ref. AU, p. 106). The last five reasons are derived from the existing conditions; only the first one is a consequence of the design of the New Town.

**First Stage of Hook's Development**

1) **Housing:** 5,068 dwellings for a population of 16,300 in high density (247 persons per hectare), medium density (175 persons per hectare), and low density (100 persons per hectare). (In figures 4, 5, and 6, the residential areas which were not of high density were shown as low density for the sake of clarity. Housing includes primary schools and local shops.) The amount of dwellings that were planned to be built per year, an average of about 1,000, is considerably higher than the amount of houses built each year in the first generation New Towns. For example, only an average of 785 houses were built each year in East Kilbride, a Scottish New Town (ref. AK, pp. 113-117).
2) **The centre:** Neighbourhood shopping at the northern end linked with the beginning of the main shopping parade to the south. The centre contains also at that stage a church, a fire and ambulance station, a youth centre, a market and a secondary school.

3) **Industry** in the north and some in the south.

4) **Major roads** providing access to the new development were built.

5) **Lakes** as required for surface water run-off and open space (see ref. AU, p. 106).

The residential areas are not only located close to the centre, but the centre also contains facilities for the provision of all essential services.

**Second Stage**

1) **Housing:** A goal of 13,232 dwellings in the town and population of 43,700. The number of dwelling units planned for the second time period is even higher than the first: an average of 1,630 units a year. (Note: Land is left open between the centre and the surrounding residential area. In the next stage, half of it will be filled in with high density housing.)

2) **The centre:** develops southwards. The shopping parade is extended southwards, and a secondary school, a technical college, a police station, a hotel, a general post office, the labour exchange, swimming baths, and offices are added.

3) **Industry:** development of a third industrial area at the south-west side of the site and extension of the other.
4) **Major roads:** all the major roads in the town are completed by at this time.

5) **Lakes**, as required for surface water run-off, and open spaces for recreation, are added.

6) **Railway and bus stations** are completed, and the old station in the west is closed.

### Third and Final Stage

1) **Housing:** to reach a total of 20,745 dwellings for a population of 70,000. Part of the land left open around the centre during the prior stages is now used for high density housing.

   An average of 1,500 dwellings are built each year during the last planned stage.

2) **The centre:** is completed in length but has openings left for future development. A town hall, a cinema, a theater, the magistrate's court, a restaurant, a church, a telephone exchange and offices are added.

3) **Industry:** At this stage, two-thirds of the land planned for industrial use is developed, and land for future expansion is reserved in all three areas.

4) **The lakes and the open spaces** are completed, and a stadium is added on the west side. Space is left open for future development even in the middle of the city, a total of about 100 ha.

   This growth plan seems completely determined after the design of the whole site. Only the location of the first development is discussed although the New Towns of the second generation were planned to be capable of further growth beyond the original size (ref. BD, p. 272).
Nothing is said about the maximum size of the town or about its growth beyond the first fifteen years, after which there might not be sufficient area in the centre to provide sufficient services. See figures 4, 5, and 6 for maps of the growth (ref. AU, p. 106-111).
HOOK NEW TOWN

- HOUSING, LOW DENSITY
- HOUSING, HIGH DENSITY
- CENTRAL AREA
- INDUSTRY
- LAKE OR RIVER
- GREEN - OPEN SPACE
- PRIMARY SCHOOL
- SECONDARY SCHOOL
- NEW ROAD
- EXISTING ROAD
- RAILROAD

LINE DELIMITING THE LANDUSES CREATED DURING THE PERIOD DESCRIBED IN THIS DRAWING

DEVELOPMENT FROM YEAR 0 'TILL 5
HOOK NEW TOWN

- Housing, low density
- Housing, high density
- Central area
- Industry
- Lake or river
- Green/open space
- Primary school
- Secondary school
- New road
- Existing road
- Railroad
- Line delimiting the landuses created during the period described in this drawing

DEVELOPMENT FROM YEAR 6 'TILL 10
HOOK NEW TOWN

HOUSING, LOW DENSITY
HOUSING, HIGH DENSITY
CENTRAL AREA
INDUSTRY
LAKE OR RIVER
GREEN - OPEN SPACE
PRIMARY SCHOOL
SECONDARY SCHOOL
NEW ROAD
EXISTING ROAD
RAILROAD

LINE DELIMITING THE LANDUSES CREATED DURING THE PERIOD DESCRIBED IN THIS DRAWING

DEVELOPMENT FROM YEAR 11 'TILL 15
The physical growth strategy used in the planning of Thamesmead, London

Thamesmead is the name given by the Greater London Council to a piece of land 525 ha. large situated along the Thames. It consists of marshy land, part of which was used for storing ammunition by the British Ministry of Defense until 1966. The Council owned a portion of the land needed and the remainder was purchased from the Ministry of Defense. It is about 12 kilometers west of London City on the south bank of the Thames. In 1966 the plan was to house 60,000 people in Thamesmead (ref. AN, pp. 3-7). Actual development started in 1967. In figure 7, year 0 is 1967. The development of the site has been progressing almost as quickly as planned. Only the plans of the physical growth strategy were able to be found (ref. BF), but comments on these were not available.

What would be the reasons why development was started in the south-west corner?

1) The site is close to existing roads and to a British Railway station. It is obvious that a part of the population will commute to London for employment.

2) The site borders on an existing development. This enables inhabitants of the new settlement to use the services of the development until their own are finished, and it allows people to move in sooner.

3) The fact that the rest of the site has to be drained before it is habitable.
4) The proximity of industries and a site for new industries, to the west.

5) The proximity of a very large recreation area south of the first development.

The growth strategy is to penetrate the site with fingers of high density housing located next to the main roads. It appears that this was chosen on purely esthetic, graphic grounds. The development first reaches out to the Thames and then spreads out to the east and to the west. The highest density housing is always built first, followed by adjacent lower density housing. Each portion of development contains primary schools, local shopping facilities, open spaces, and is accompanied by an enlargement of the centre and the industrial area at all times. There is employment on the site for nearly twenty percent of the population, as compared with twenty-five percent of the population employed on the site of Vällingby. The larger percent needed in Vällingby can be explained by the fact that the family size is much smaller in Sweden than in Britain. Therefore, for the same population, there are more heads of family in Sweden than in Britain.

In Britain one hectare of area is considered necessary to employ 74 to 84 people in manufacturing or industry (ref. BD, p. 272). In Thamesmead the development speed is to be dependent on the availability of a labour force to build it. Ten million British pounds worth of civil engineering and building per annum would require approximately 2,000 men on the site. 1,000 dwelling completions per annum with industrialized building on the site would require approximately 800 men on the site.
The contractors involved in the building of the project estimated that such a large labour force could only be assembled with difficulty, and this alone would lead to an extension of the development time. This was considered a disadvantage since it would increase the financial charges by keeping land undeveloped longer. Note that an industrialized housing factory is built on the site during the first year of development. The production capacity of the plant is then gradually increased. After the final year of development, only a small area to the west is left for future industrial development. The large space on the east side is reserved for extending the sewage treatment plant.

The physical growth strategies of Hook and Thamesmead are quite similar. Both grow by juxtaposition of new residential areas next to existing ones.

In Hook commuting by rail is discouraged from the beginning, while it is made possible in Thamesmead. In both cases the first development was made near existing housing, roads, and services.
THAMESMEAD, LONDON

Fig. 7

HOUSING, LOW DENSITY
HOUSING, HIGH DENSITY
CENTRAL AREA
INDUSTRY
LAKE OR RIVER
GREEN - OPEN SPACE
PRIMARY SCHOOL
SECONDARY SCHOOL
NEW ROAD
EXISTING ROAD
RAILROAD

LINE DELIMITING THE LANDUSES CREATED DURING THE PERIOD DESCRIBED IN THIS DRAWING

DEVELOPMENT FROM YEAR 0 'TILL 3
THAMESMEAD, LONDON

Housing, low density
Housing, high density
Central area
Industry
Lake or river
Green - open space
Primary school
Secondary school
New road
Existing road
Railroad

Line delimiting the landuses created during the period described in this drawing

Development from year 4 'till 6
THAMESMEAD, LONDON

HOUSING, LOW DENSITY
HOUSING, HIGH DENSITY
CENTRAL AREA
INDUSTRY
LAKE OR RIVER
GREEN - OPEN SPACE
PRIMARY SCHOOL
SECONDARY SCHOOL
NEW ROAD
EXISTING ROAD
RAILROAD

LINE DELIMITING THE LANDUSES CREATED DURING THE PERIOD DESCRIBED IN THIS DRAWING

DEVELOPMENT FROM YEAR 7 'TILL 11
THAMESMEAD, LONDON

1. HOUSING, LOW DENSITY
2. HOUSING, HIGH DENSITY
3. CENTRAL AREA
4. INDUSTRY
5. LAKE OR RIVER
6. GREEN - OPEN SPACE
7. PRIMARY SCHOOL
8. SECONDARY SCHOOL
9. NEW ROAD
10. EXISTING ROAD
11. RAILROAD

LINE DELIMITING THE LANDUSES CREATED DURING THE PERIOD DESCRIBED IN THIS DRAWING

DEVELOPMENT FROM YEAR 12 'TILL 15
Columbia is located between Washington and Baltimore. It is a private venture by the Rouse Corporation, and its only motive in the end is profit. Although it is called a New City it will have the aspect of American middle class suburbia: a lot of roads and a majority (70 per cent) of single family detached houses. The aim is to have a city of 120,000 inhabitants after 15 years. The population will be middle class and will commute to Washington, Baltimore, or suburban industries for employment. 6,000 hectares were bought within three months for the Rouse Corporation by dummy buyers. Only then an economic and feasibility study was made to determine whether the purchased land was worth developing, or if it was more profitable to sell it in the near future as subdivisions. At that time a large collection of data was compiled. It could not be done before, because a large scale inquiry would have aroused the attention of landowners, raised land prices, and would have diminished or annihilated the potential profit of the Rouse Corporation. The aim was to attract middle class people. A study was made about the prime factors in their choice of residential location. It was found that they consider the most important factor the quality of the school their children will have to attend. It is not clear how they distinguish bad, good, and better education, but it is certain that anything new, and experimental will have a favorable impression. The only thing the Rouse Corporation had no control over was the County Board of
Education. The schools were set up very conservatively and were not likely to attract people who wanted something special for their children. The Rouse Corporation flew the Board of Education around the United States to show them several kinds of progressive and experimental schools. Whether convinced or gently forced, the Board of Education decided to allow the establishment of an up-to-date school system in Columbia. Now the Rouse Corporation could add to the attractiveness of Columbia by advertising it extraordinary school system. And it worked!

In Columbia no house is sold before schools, parks, shopping, open spaces are already available for it. The Rouse Corporation calls this "Preservicing". The first stage consisted of one neighbourhood of 2,000 to 3,000 people with preservicing. The centre was started as soon as a few neighbourhoods were built.

No plans of the growth of the City were found, but it is known that these neighbourhoods are not contiguous. They are built out of each other in order to raise the price of the land between them. To alleviate the inconvenience of the settlement being scattered over the site, the Corporation promised to provide an alternative to private car transportation. This would have encouraged families to own only one car, because wives and children could have used the public transportation for their movements around the town. Although many systems were considered, none were economically feasible, and in the end, no alternative transportation was provided.

The pace of the development was controlled by an economic model, a highly complex series of projections and conjectures showing when and how the investors would get their money back and then
make a substantial profit. The fact that the company was paying carrying charges and taxes on $23,500,000 worth of land created pressure to develop the land rapidly. But the longer land is left undeveloped, the more its value will rise. The economic model computes how much and what kind of development is needed to produce just enough cash flow to pay off the charges (refs. AV, AB, AT).
CONCLUSIONS

Although physical growth strategies seem to be very dependent on local conditions, some further constants can be isolated:

1) **Disregard for growth**

Most growth strategies seem to be designed to help the implementation of a Master Plan, and it does not seem that the Master Plan was very influenced by the growth strategy. It is perhaps the same phenomenon as if the design of a product does not take into account the way it will be manufactured.

2) **Pre-servicing**

In all growth strategies the need for pre-servicing is insisted upon. This means to provide all utilities and the elementary services together with the houses. What the elementary services are differs from case to case, but some are common: primary schools, local shops for daily needs, open space on the neighbourhood level, secondary schools, major shopping areas, churches, public transportation, recreation facilities, and open space on the town level.

3) **Employment**

There is a need to provide employment on the site, from the beginning, as an alternative to commuting.
4) **Complete compact environment**

The need to make a compact, viable environment with an urban character from the beginning as seems to be a concern in most growth strategies. An exception must be made for those parts of the United States where the rural tradition still persists. As an example Columbia, Maryland will certainly not have a compact, urban aspect, either in the beginning or at the end, when 70 percent of it will be comprised of single family detached houses.

5) **Location near existing services, utilities and infrastructure**

The first development is usually located near existing housing to be able to minimize the initial cost in infrastructure and utilities. In the first months of the initial stage, the schools and shopping facilities are either unfinished or the population too small to open them. Then the facilities nearby can be used temporarily. But care must be taken that the new residents do not form the habit of using the facilities outside the development.

6) **Methods of growth**

There are roughly two ways to let a development grow: either by adding new parts to the already existing ones and so creating a continuum, or by starting the development in distant spots and then filling in by spots until all the land is used. The first alternative gives the opportu-
nity to the new settlements of taking advantage of the services and utilities already established nearby, just as the first development can take advantage of already existing housing. The second alternative was used in Columbia New City, because the land between developments rises in price. On the other hand, although the first inhabitants might have the advantage of a lot of open space around their community for a short time, they have the inconvenience of having to travel very far to the central area and the other parts of the future town. Because of the distances, it is probably very difficult to understand the structure of the whole town and relate to the different parts.

7) **Treatment of the central area**

The centre of the settlement has to be started as soon as possible. To finish a number of districts complete with their amenities before work is started on a future town centre is not generally considered to be justified, since there is a risk that certain of its functions will be fulfilled outside this centre, and the integration of the centre and the districts or neighbourhoods may thus be more difficult or impossible. But it is not enough to build that centre, it must also be easily and cheaply accessible, either by foot, bicycle, or public transportation.
8) **Size of development stages**

The size of the steps, usually measured in years, of the development of a large community seems to be carefully calculated in most cases. In Thamesmead it depends upon the labour force available to build each stage. In Columbia, the Corporation wants to build the minimum necessary to pay off the loans undertaken to purchase the land. In Hook and other British New Towns, the size of the steps seems to have an optimal upper limit determined by the availability of a local labor force and the amount of money contributed by the central government, and a minimum size dictated by the building volume required to take advantage of the mass production methods that will reduce the final cost. Aside from this, there seems to be an optimal size after which the steps become harder to control and coordinate.

The graph showing the incremental change of the capital expenditure, the population, the employed construction labor, the jobs, the area of parks, commercial facilities, and the roads and utilities, as a function of time, is bell-shaped. This means that the first and last steps are smaller, and that the largest increase lies between them. It is impossible to say whether the largest step should fall closer to the beginning or the end. This kind of planning was very clearly used in the case of Thamesmead.
9) Need to provide vacant land

The need to leave land open for future development seems to be generally accepted. In most British New Towns large tracts of land are left open for the future. In Thamesmead there is almost no space left for expansion on the site. But this was done probably because the housing development existing at the south of the site is aged and will probably soon be ready for rehabilitation or bulldozing. In the case of Vällingby a lot of land now in use as wooded open space could be used for further expansion, but the tendency exists in the Scandinavian countries to resist pressure for growth if it is believed that the expansion would harm the equilibrium reached after full development.

10) Change of the growth strategy over time

The fact that the growth strategy and the Master Plan of a development are to be redirected after a certain time is not insisted upon, it seems to be commonly accepted. It is normal that changes in technology, in life style, will change the goals of the development. The success of a growth strategy lays more in its implementation than in its design.

A passage out of a paper named "Economic Problems in Developing New Towns and Expanded Towns", presented by Professor Lloyd Rodwin at the "Round the Table Conference on the Planning of New Towns"
organized by several United Nations Bureaus in Moscow in 1964, confirms some of the foregoing conclusions:

"A major problem is the need to co-ordinate the staging of development: the organisation of economic activities and the provision of public services, housing and of community and shopping facilities. Imbalances can cause harrowing difficulties (Brode William, Industrial Estates: Tool for Industrialisation, Glencoe, Illinois; The Free Press, 1960). If the rate of growth is slow, the financial burden may become dangerously high. If it is too rapid, provision of services may not keep pace. If the economic activities are established before the housing is available, recruitment snags. If the houses are provided first, they may remain vacant; or if occupied, they may require long journeys to work. If public land use is programmed (parks, playgrounds, and other public uses) implementation machinery weak, the site may be an open invitation for squatters. If the infrastructure is provided in advance for the whole town, or large segments thereof, considerable waiting costs may be entailed until development catches up. And if, as already noted, neighbourhood shopping facilities are provided as neighbourhoods are built, the town centre may never acquire the intensity or distinction desired; but if the facilities are delayed or not provided, inconvenience and discontent is the lot of the inhabitants during the first decade. What is more, since no developer, public or private, can provide all of the essential facilities, the phasing of the programming is constantly at the mercy of other agencies and groups whose co-operation must be obtained via bargaining, suasion, threats and other means." (See ref. AY, pp. 14 and 15.)
SOME BASIC FACTS AND FIGURES ABOUT PUERTO RICO AND SAN JUAN

History
1493 The island was discovered by Christopher Columbus and claimed for Spain. Up until this date Puerto Rico was called Borinquen by the Arawk Indians who inhabited the island.
1898 Puerto Rico was ceded by Spain to the United States as a consequence of the Spanish-American war.
1953 Operation Bootstrap was started to raise the standard of living through industrialisation.
1957 Industry surpassed agriculture as the major source of income of the economy.

Demography
Density: 305 persons per km², highest in Latin America after Haiti
Population: 1970: San Juan only: 750,000
Puerto Rico: 2,758,000
forecasts for 1980:
San Juan only: 1,400,000
Puerto Rico: 3,600,000
**Political situation**

Puerto Rico is permanently and irrevocably linked to the United States on the basis of a common citizenship, a common defense, a common market, common currency, common postal system, free exchange of people and goods, and a common access to the Supreme Court of the United States. While no federal taxes apply to Puerto Rico, the Commonwealth retains the power to levy internal taxes for its own use, but it receives a large share from federal programs: Education and Welfare, Housing and Urban Development, and Transportation.

**Planning Organization**

1) Puerto Rico has a building code and zoning regulations parallel to those found in the United States.

2) The Planning Board of Puerto Rico (Junta de Planificación) has the responsibility of guiding urban development, and powers necessary to adopt and apply regulations to guarantee that the said development is in harmony with the needs.

3) C. R. U. V. (Corporación de Renovación Urbana y Vivienda) develops and directs operational programs and projects to fulfill the goals of Public Housing and Urban Renewal policies. The four types of programs are:

   a) the Urban Renewal program

   b) the program of federal public housing
c) administration and maintenance of existing housing projects

d) developing new types of projects to complement federal aid housing

(Excerpts of the information compiled in ref. AW, pp. 1.1 to 1.10)

**Transportation in the San Juan area**

Most of the transportation in the San Juan area is by private car. Public transportation is available in the metropolitan area by means of buses. But the service is infrequent and the fares relatively high. Traffic congestion is a serious problem in the San Juan metropolitan area.
LOCATION OF FINCA LA MARINA

Fig. 12
- THE FINCA LA MARINA SITE

Origin of the name
The site was owned previously by the U.S. Navy, and "Finca" means farm or estate in Spanish, thus the name means "estate (of) the Navy".

Present land ownership
The Commonwealth of Puerto Rico, through its "Administration de Terrenos" (Land Bank), controls the entire proposed site.

Location
In the San Juan metropolitan area, in the municipality of Carolina, Puerto Rico. It is approximately six kilometers from the new City centre at Hato Rey. The site borders the San Jose Lagoon and the Suarez Channel passes through the interior of the site.

Access
One of the largest freeways in San Juan region borders the site in the North. Future plans include a network of freeways which will surround the area. The future mass transit network will pass within easy access of the site. Bus access is available at the North and the South of the site.
FINCA LA MARINA, SAN JUAN

EXISTING SITUATION, 1971
FINCA LA MARINA, SAN JUAN

HOUSING. LOW DENSITY
HOUSING. HIGH DENSITY
CENTRAL AREA
INDUSTRY
LAKE OR RIVER
GREEN - OPEN SPACE
PRIMARY SCHOOL
SECONDARY SCHOOL
NEW ROAD
EXISTING ROAD
RAILROAD
LINE DELIMITING THE LANDUSES CREATED DURING THE PERIOD DESCRIBED IN THIS DRAWING

PLANNED FREEWAY
Area of the site

191.5 hectares, with the area for the future freeway to the south of the site; the area to the north side of the Suarez Channel is 52 ha; the area between the channel and the freeway bordering the south of the site is 124 ha. The rest of land, 15.5 ha, lies south of the freeway.
(See ref. AE, p. 1.0.)

Main features of the site

The location of the site next to the San Jose Lagoon affords excellent views of the new city centre across the lagoon; the site is relatively flat, with small trees lining the lagoon front and the channel.

- ALTERNATIVE USES OF THE FINCA LA MARINA SITE

1) Untouched

The site could be left untouched for a period of time as a reserve for the future needs of the metropolitan area. Puerto Rico would then be one of the only capitals in the world to have a very large tract of land unused in its metropolitan area. If the land is left untouched, criteria must be set up to define the point in time and the purpose for which the
site should eventually be used. However, this alternative is not viable at the time, because the members of the Puerto Rican Planning Board feel pressured to use the land.

2) Recreation

It could become a regional recreation centre, but an area northwest of it along the coast has already been designated for this purpose.

3) Industry

It could be used to contain the industry that usually is located near an airport. The location of industry there would certainly tend to reduce the commuting of workers from the municipality of Carolina to the municipalities of Hato Rey and Catano where most of the industry is now concentrated. The industry would fit in well next to the few industries that are already established around the site. The noise pollution produced by the airport and the surrounding expressways can be used as an argument for using the site for industry rather than for housing.

4) Residential

The Planning Board of Puerto Rico published in a report named "San Juan, Choices for Changes", (1967), four alternative plans for the development of San Juan (see ref. Al, pp. 16, 20, 24, 28).
All of them defined the site as land to be used for *residential development* with a strip of open space for recreation along the canal, which later totally became residential use. Two plans stipulated high density residential, one medium density, and the last, a combination of medium and high density residential.
- GOALS FOR THE DEVELOPMENT OF FINCA LA MARINA

C. R. U. V., the "Corporacion de Renovacion Urbana y Vivienda" is planning to use the site for high or medium density residential, which will be accepted in the development of this thesis.

The goals set in this thesis are:

1) **Independence**

   We want to create a city segment that can live by itself, without dependence on other parts of the city, to palliate the congestion in the San Juan area. We plan to allow for this independence at each stage of the development to avoid accustoming the population to working, shopping, or going to school outside the site by including these facilities initially.

2) **No dominance by the car**

   We want to create a living environment where the nuisance of private cars is kept to a minimum for the majority if not all people, by making short trips by foot or by public transportation more attractive than by car. This goal is discussed in Appendix 3.

3) **Best locations for low-income housing**

   The aim is to situate the lowest income people closest to the central area in order to enable them to reach it without public transportation; to situate them closest to the most scenic
parts of the site, along the Lagoon and the Canal, since the low income people are the least likely to be able to see anything else except their dwelling and workplace environment.

Not all of these goals are expressed in the designs to be found in the next pages, but the purpose of this thesis was not to make a site plan, but a growth outline to be used for the design of a site plan.
CHOOSING THE STARTING POINT FOR THE DEVELOPMENT

Deciding whether building should begin in the north or the south section of the site, and after this decision, choosing between the east and the west side.

A) SIMULTANEOUS DEVELOPMENT OF BOTH SECTIONS OF THE SITE

Advantage:
The site will have more chances to develop as an entity, with a "site spirit" rather than with a "North side" or "South side" spirit.

Disadvantages:
1) Scattering of resources.
2) The developing agency would probably have to build a bridge connecting both sides early in the development.
B) DEVELOPMENT OF THE NORTH SIDE FIRST

Advantages:
1) Proximity to two existing primary schools.
2) Easy access to the Loiza Freeway and from there to Old San Juan.
3) Possibility of an economical connection with the utility lines of the existing development between the site and the Loiza Freeway.
4) Accessible by bus on the north side.

Disadvantage:
The development of this side might be very difficult and unrewarding because of the narrowness of the site.
B1) DEVELOP THE WEST PART OF THE NORTH SIDE FIRST

Advantages:
1) The site is the widest at this section (about 450 m).
2) Closest to one of the existing schools.
3) Closer to the lagoon.

Disadvantage:
None

B2) DEVELOP THE EAST PART OF THE NORTH SIDE FIRST

Advantage:
Closer to an existing sewer and water main.

Disadvantages:
1) The site is very narrow at that place (about 150 m).
2) Squeezed between two freeways.
3) Too far from schools and commercial facilities.
C) DEVELOP THE SOUTH SIDE FIRST

Advantages:
1) There is one school in the neighbourhood.
2) There is a commercial area of about 600 meters from the centre of the south side.
3) There is employment opportunity in a light industry area at the east side of the south side.
4) The site is quite wide (about 750 m) and will give an opportunity to the designers to make an innovative design that could stand out against the suburban type of private developments.
5) Access by bus on the south side.

Disadvantages:
1) The south side will be completely cut off from the rest of the San Juan urban tissue by the Torrecillas Freeway. The south side will probably grow affinities with the existing development to the south of it and these will then be suddenly cut off by the freeway.
2) A large part of this side has to be overloaded to improve the soil conditions. This requires three years waiting time before the use of that part of the site.
C1) DEVELOP THE WEST PART OF THE SOUTH SIDE FIRST

**Advantages:**
1) The site is the widest in that part (about 700 m).
2) It is closer to the lagoon.

**Disadvantage:**
This part is cut off from its commercial services and the urbanization to the south of the site by the future freeway and a canal.

C2) DEVELOP THE EAST PART OF THE SOUTH SIDE FIRST

**Advantage:**
Closer to an existing sewer and water main.

**Disadvantages:**
1) The site narrows to only 150 m at this point.
2) It is squeezed between a freeway and two canals.
3) It is far from schools and commercial facilities.
THE DECISION WAS MADE TO STUDY THE GROWTH STRATEGY WHEN BUILDING WAS STARTED IN THE MIDDLE OF THE SOUTH SIDE OF THE SITE.

Both sides have most of the same advantages:

1) At least one existing primary school in the neighbourhood.
2) Access to the metropolitan freeway network either at present or in the near future.
3) Accessibility by bus.

The south side, however, was wider and therefore less difficult to develop. The middle section of the south side does not have the disadvantages of the east and west parts, and it is closer to the school and commercial facilities. Additional reasons for the choice of the location for the initial stage of development are given in the section "Growth Strategy for the Development of Finca La Marina".
DESIGN DECISIONS FOR THE SITE PLAN

The goal was to start working with the computer aided design system without a definite site plan for the development of "Finca La Marina", so that the site would be more a consequence of the growth strategy. But one cannot make a growth strategy without a final product to aim for.

Before and while using the "IMAGE" computer aided design system some strong design decisions were made. The author became fully aware of these only after using "IMAGE". We list them here because they help explain what follows in the next pages. The major design decisions were:

1) **Industry** had to be located along the future freeway bordering the southern section of the site to act as a buffer zone between the residential areas and the freeway, and to provide alternative employment for the inhabitants of the site. It was thought that 150 m represented the most advantageous lot depth for light industry.

2) The **central area** had to be located in the middle of the site, the largest part on the south side of the canal, and a smaller portion on the north side. Both parts of the central area are to be connected by at least a pedestrian bridge.

3) **Roads**: On the south side of the site, a "one-way loop road" is to be built (details to be found in Appendix 3, p. 116). This loop road had to be 100 meters from the widening of the canal, the minimum distance at which the land between the road and the canal was still wide enough for residential development. Nearer the Lagoon, space between the road and canal was
to be expanded because the site widens at this point. There was to be no residential development between the road and the industrial area.

On the north side of the site, it was planned that the road would be built as close as possible to the existing development to allow for the maximum distance between the road and canal. A larger area allows greater freedom in choosing a site plan.

4) **Schools**: Secondary schools were planned near the canal.
- PROPORTIONS IN LANDUSE CHOSEN FOR THIS STUDY

The figures used in this section were gathered from various sources and are meant only for reference. The compilation of precise figures warrants a separate detailed study by itself. However, the figures mentioned will adequately serve as the approximate statistical basis needed for this discussion.

Density

A medium high density was chosen for the development, 90 dwellings per hectare based on C. R. U. V. guidelines, with an average family number of 5, a density of 450 people per hectare, based on C. R. U. V. guidelines. The residential areas include primary schools and local "corner shops", and parking garages.

Employment

In Sweden's Vällingby, 25% of employment is provided on the site of a town extension, and about the same number in the case of Thamesmøed. The family size is much larger in Puerto Rico than in Sweden, 3.2, or in England, 3.7. The availability of the airport and existing industries led us to choose the figure of 12.5% of the population employed on the site. Even if this figure could be changed up 7.5% or down 2.5%, it would really not change the concept. We used the
accepted approximation that in manufacturing, 100 people can be employed per hectare, to determine
the area to reserve for industry.

Area standards used

The space needed for the central area was difficult to approximate. In 1962 the Puerto Rico
Planning Board issued a document containing guidelines for the planning of residential developments.
In this, standards were set for some commercial and cultural facilities. The maximum capacity of
commercial area was 3.71 m² of floor area and 25 m² of lot area per dwelling unit. The area of a
cultural centre was stipulated to be 0.65 m² of floor area and 5 m² of lot area per dwelling unit.
The area for a public library had to be 0.1 m² of floor area per dwelling unit. (See ref. AK,
p. 7,9.)

We accepted before an average family size of 5 people. A central area containing only
commercial facilities, a cultural centre, and a public library would then be sized by the following
approximate rule: 0.88 m² of floor area, and 6.06 m² of lot area per inhabitant. Such a calcula-
tion does not include facilities needed in a central area that will eventually serve at least
30,000 people, such as a medical centre, a post-office, an administrative centre, offices, churches,
etc. We chose to reserve for the central area 3.5 m² per inhabitant, spread in an average of two
floors: 1.75 m² per inhabitant. We planned the same area for parking as for the activities they
serve, according to accepted approximations. This area spread over an average of 3 stories is
equal to 1,16 m² per inhabitant. The total area needed for the centre is then 2,91 m² per inhabitant. The same guidelines specified the area of the development to be used for roads not to be larger than 15% of the total area. The figure used is smaller than that and is only a rough estimate.
Land available

1. north side: one tract 52 ha
2. south side: 4 tracts 124 ha
3. 7.5 ha
4. 3 ha
5. 5 ha

Both sides: Total of 191.5 ha

Fig. 22
<table>
<thead>
<tr>
<th>Landuse</th>
<th>North section:</th>
<th></th>
<th>South section:</th>
<th></th>
<th>Total:</th>
</tr>
</thead>
<tbody>
<tr>
<td>residential</td>
<td>31 ha</td>
<td>45 ha</td>
<td>76 ha</td>
<td>60 %</td>
<td>39.7 %</td>
</tr>
<tr>
<td>industry</td>
<td>3 ha</td>
<td>42.5 ha</td>
<td>45.5 ha</td>
<td>5.8 %</td>
<td>23.8 %</td>
</tr>
<tr>
<td>central area</td>
<td>3 ha</td>
<td>6 ha</td>
<td>9 ha</td>
<td>5.8 %</td>
<td>4.7 %</td>
</tr>
<tr>
<td>roads</td>
<td>7 ha</td>
<td>14.0 ha</td>
<td>21 ha</td>
<td>14 %</td>
<td>10.9 %</td>
</tr>
<tr>
<td>left for open space and</td>
<td>8 ha</td>
<td>32 ha</td>
<td>40 ha</td>
<td>14.4 %</td>
<td>20.9 %</td>
</tr>
<tr>
<td>secondary schools</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>52 ha</td>
<td>139.5 ha</td>
<td>191.5 ha</td>
<td>100 %</td>
<td>100 %</td>
</tr>
</tbody>
</table>
With these proportions in land use the site could house 34,200 people in 6,840 dwellings and employ 4,550 people in manufacturing.
Proposed Means

Planning regulations specify the amount of services to be provided in a residential development as a factor of the number of dwellings. The Puerto Rican Planning Board specifies, for example, that a developer must provide a school for 900 dwellings. This is the balance that must exist at the end of the development. But one cannot wait until the number of dwellings required to support a facility is attained to put it in service, if one wants to provide pre-servicing. Although it would be ideal, one cannot provide facilities as soon as the first inhabitant of a development moves in. We must find ways to lower the minimum of dwellings necessary to support facilities in order to make them available earlier.

1) Schools

A school planned to have more than one class per grade can start operating with only one class per grade. We can still further advance the opening date of a school by letting it operate with the minimum number of students possible.

A first school can operate for a while above the optimal student number until there are enough
families to support two schools. Note that the opening of schools is dependent on the academic calendar. This should be taken into account when planning the starting date of a development.

2) Commercial facilities

Commercial facilities are controlled by the private sector, whose only motive is profit. We will discuss some ways to hasten the opening of a department store in the central area. If a certain department store needed 4,000 dwellings to support it to operate at profit, and the average building rate of the development was 500 dwellings a year, the inhabitants of the development would have to wait eight years for its opening. One could advise the owners of the department store to build only half the store at first, but this would still be too long for the future customers to wait.

The land and the structure of the central area might remain the property of the developing agency. The agency could then attract commercial firms early by allowing them to operate free of rent for a determined number of years, or until the gross income of the store exceeds a certain figure. The rent could then stay proportional to the gross income. This policy would attract both small and large facilities earlier.

3) Industry

This same type of policy could be used to attract industries.
Time and size of each development step

We assumed a feasible time span for completion of the development to be fifteen years. The first three years are used for preparation of the site. The next twelve years are spent building residences, the industry, and the services for them.

We will show the progress of the development every two years. We assumed that a maximum of 700 residences, the industry, and services could be built in one year. This figure could be defined exactly taking into account the factors discussed in Appendix 2. Fewer residences are built at the beginning and at the end of the development.

Proposed strategy

Several alternatives could have been presented, but they probably would have differed very little from the strategy presented here. The strategy presented here is believed to be the optimal for the author's conception of the problem. Others could have been generated with other perceptions of the problem.

It was attempted to simulate the growth strategy with the IMAGE system and then translate the results into conventional graphics. During the generation of the third phase with the IMAGE system it was decided to continue the simulation by hand. Here follow some notes on the decisions that led to the design of the growth strategy.
0) Preparation of the site: Development from Year 0 till 3

It seems advantageous that the 95.5 ha of unstabilized land be loaded as soon as possible, even before final decisions on the development are made, since it requires about three years for the overloading to have full effect in making the land ready for construction. Even if the development is not realized, the developing agency, C. R. U. V., can still sell the land to private developers for at least $20 per m², an $8 per m² profit, not taking into account financial charges.

1) First phase: Development from Year 3 till Year 5

A bus line has its terminal in the middle of the southern boundary of the site. The bus line could easily be extended to make a loop passing through the site, the existing school and commercial area, south of the site. This would make school and commercial facilities easily accessible from the beginning of development. The first loop was specified to be built far enough away from the Torrecillas Freeway in order to allow for an industrial zone between the loop road and the freeway. The loop road had also to stay far enough away from the widening of the canal to leave enough land to be used for residential development and for the central area. The northwest corner of the loop road was meant to be at the centre of the site, and
to pass under the centre of the central area.

The first residential development was to be built together with the first part of the central area and the first industry. The residential area had to be between the central area and the exit of the road leading to the high school in the existing urbanization, but closer to the central area than to the school. The first industry was specified to be close to the existing road to minimize the length of road and utilities to be provided.

Size of first phase

Residential area: 8 ha - Comprising 720 dwellings, housing 3,600 people, one primary school, one corner shop, and 720 parking spaces in parking garages.

Central area: 1 ha - Comprising the first part of a supermarket, a few small shops for artisans, a fire station and a medical centre. The central area consists of 1.2 ha floor area for shops, pedestrian mall and services, spread over an average of 2 stories, and 1.2 ha of parking space, spread over 3 stories.

Industrial area: 2.25 ha - To employ 225 people. We stated that the aim was to provide employment for 12.5% of the population on the site. In the first phase 450 jobs would be needed. Since all new settlements had a hard time attracting industries in the first years of their development, we thought it would be too optimistic to represent the target area of 5 ha.
2) 

Second phase: Development from Year 5 till Year 7

A second residential development is built to the west of the first. It is larger than the first and accompanied by a loop road, and an addition to the central area. Since the site is wider, the loop road may be situated further away from the canal. More industry is provided to the north and the south of the existing industry. A secondary school and a recreation park are provided along the canal as close as possible to the central area. Space is left between the recreation area and the park for extension of the central area.

Size of second phase

Residential area: 12 ha - Comprising 1,080 dwellings, housing 5,400 people, two primary schools, two corner shops, and 1,080 spaces in parking garages.

Central area: 2.25 ha - Comprising an addition to the existing supermarket and the first section of a department store, more small shops and artisans, a church, a cultural centre, and a post office. In this stage, 4.15 m² of central area per inhabitant housed in the same period is added. This is higher than the accepted average of 2.91 m² of central area per inhabitant, because many services are provided before the population level is attained which will fully support them.
Secondary school: 2 ha

Recreation park: 2 ha – Containing a soccer and a baseball field to be used by the secondary school students and the rest of the community.

Industrial area: 6.75 ha – are added to employ an additional 675 people, 12.5% of the population added during the second phase.

**Level at the end of the second phase:**

- 1,800 dwellings
- 9,000 inhabitants
- 900 jobs
- A central area capable of serving 11,170 people

3) **Third phase: Development from Year 7 till Year 9**

More residential development is built between the Lagoon and the existing development, and the loop road is connected with the rest of the city south west of the site. A second residential development is built during this period on the north side of the canal, near the existing school. This will allow children to go to school in the neighbourhood before the new school is finished. The new residential area is connected to the central area and the rest of the
site by a road and a bridge. The central area is extended to the other side of the canal, but both sides remain connected by foot bridges over it. The industrial area is located at walking distance from the new residential area on the south side of the site.

Size of third phase

Residential area: 15.5 ha - Comprising 1,400 dwellings, housing 7,000 people, two primary schools, two corner shops, and 1,400 spaces in parking garages.

Central area: 2.5 ha - Containing additions to an existing department store, and additional smaller shops. Most services are still underused in this period.

Recreation park: 2 ha - Along the Lagoon, it could be coupled with nautical club activities.

Industrial area: 8.5 ha - are added to employ an additional 850 people, about 12.5% of the population added during the third phase.

Level at the end of the third phase

3,200 dwellings
16,000 inhabitants
1,750 jobs

a central area capable of serving 19,760 people
4) **Fourth phase: Development from Year 9 till Year 11**

Two residential areas are built along the Lagoon, one residential area is built close to the central area on the north side of the site, and another east of the central area, completing the residential development inside the loop road. The central area is extended on both sides of the canal, and the new areas are connected by foot-bridges over it. A secondary school is built to serve the north side of the site.

**Size of the fourth phase**

- **Residential area:** 15.5 Ha - Comprising 1,400 dwellings, housing 7,000 people, two primary schools, two corner shops, and 1,400 spaces in parking garages.
- **Central area:** 2.5 Ha - Containing the second part of the cultural centre, a swimming pool, and a few shops.
- **Recreation park:** 2 Ha - Along the Lagoon.
- **Industrial area:** 8.5 Ha - are added to employ an additional 850 people, about 12.5% of the population added during the fourth phase.
Level at the end of the fourth phase

4,600 dwellings
23,000 inhabitants
2,600 jobs
a central area capable of serving 28,400 people

5) Fifth Phase: Development from Year 11 till 13

A road and a bridge are built connecting the north and the south section of the development on the east side of the site. The road connects the whole site with the service road to the airport of San Juan. This will allow residents of the site easy access to jobs in and around the airport, and enable industries connected with the airport to locate on the site. Most of the residential development during this period is done north of the canal. The central area is extended at both sides of the canal.

Size of the fifth phase:
Residential area: 15.5 Ha - Comprising 1,400 dwellings, housing 7,000 people, two primary schools, two corner shops, and 1,400 spaces in parking garages.
Central area: 0.5 Ha - Containing additions to existing services that might seem necessary.

Industrial area: 10.5 Ha - are added to employ an additional 1,050 people, or 15% of the population added during the fifth phase. Industry will be easier to attract as the site fills up with people and other industries.

Level at the end of the fifth phase:

- 6,000 dwellings,
- 30,000 inhabitants,
- 3,650 jobs,
- a central area capable of serving 30,500 people

6) Sixth Phase: Development from Year 13 till 15

The existing residential development is extended at the east side of the site on both sides of the canal. Enough space is left to allow expansion of the central area. The space left open should not be touched for at least five years to make sure that the settlement retains
space for future adjustment. At that time the community will be formed and will show interest in the decision to use the reserved land. One more secondary school is added.

Size of the sixth phase:
Residential area: 9.5 Ha - Comprising 840 dwellings, housing 4,200 people, and 840 spaces in parking garages.
Central area: 0.25 Ha - Containing additions to existing services that might appear necessary.
Industrial area: .9 Ha - are added to employ an additional 900 people.

Level at the end of the sixth phase:
6,840 dwellings,
34,200 people,
4,550 jobs,
a central area capable of serving at least 34,200 people.
WHAT IS THE IMAGE SYSTEM?

IMAGE is a graphically and verbally interactive communication system for the generation of testable solutions of problems defined by a network of weighted constraints. IMAGE has the advantage of being able to solve problems which are over or under or exactly constrained.

It is not yet a tool available for every designer. It could be developed in a relatively short time to be operational with the necessary man power and money. But the purpose of the IMAGE research is mainly educational, the process of research is more important than the end product. The project has been funded throughout by National Science Foundation grants. The use of IMAGE for the simulation of the growth of Finca La Marina was mainly to test the functioning and the range of applicability of the system. For more details see refs. AR and AS.

HOW DOES ONE SPECIFY A PROBLEM IN THE IMAGE LANGUAGE?

IMAGE issues commands by which one is able to MAKE and CHANGE surfaces. Surfaces are not only defined in dimension, but also in position through coordinates. Some other properties of usesurfaces (the term we used for the rectangles) are specified through attributes. A usesurface
can become deformable, transparent, opaque, fixed, movable, overlapable, or exclusive, etc....

The criteria to relate usesurfaces to one another are expressed through constraints. The constraints most often used in IMAGE are:

**PROXIMITY**
- is satisfied when the two usesurfaces are touching.

**RANGE**
- is satisfied when the two usesurfaces are located within a specified distance range of each other. This range can consist of equal numbers, and these equal numbers can be null; then the range constraint functions the same way as the proximity constraint.

**OVERLAP**
- is satisfied when the two constrained usesurfaces overlap each other entirely.

**ALIGN**
- is satisfied when the two constrained usesurfaces are aligned horizontally or vertically.

**COLINEAR**
- is satisfied when one constrained usesurface is located on a line passing through the other two.

**VISUAL ACCESS**
- is satisfied when none but the transparent specified usesurfaces are located inside the sightlines between the two constrained usesurfaces.

**CONSTANT AREA**
- is satisfied when the constrained surface has the surface specified in the constraint.
HOW DOES ONE GENERATE SOLUTIONS IN THE IMAGE SYSTEM?

The IMAGE system generates solutions to a problem through the least mean square approximation. Five of these approximations are done for each display of a solution. During one or more of these approximations, some constraints can be ignored or the way they are satisfied can be altered. This allows us to influence the machine generation.

In the Finca La Marina problem, we used:

Relaxation: This is the term used to describe a normal machine generation in the IMAGE system, a sequence of five approximations. It is used for stabilized refinements of alternatives.

Perturbation: During the first of the five approximations, usesurfaces whose constraints are not satisfied are allowed to roll past usesurfaces that kept them in an "unsatisfied position". It is also used to perturb an alternative into another solution space.

Move: does not change the approximation sequence, but allows usesurfaces to move, to change their dimensions, and their attributes.

Only the capabilities of the IMAGE system that were used for the following problem are explained here. A complete description of these can be found in the references AR and AS.
SIGNIFICATION OF THE USESURFACE NAMES USED IN THE IMAGE SYSTEM FOR THE SIMULATION OF THE GROWTH OF FINCA LA MARINA.

LAG1 and LAG2 : two usesurfaces used to approximate the San Jose Lagoon.

RSD1, RSD2 and RSD3 : existing residential developments.

IND1 and IND2 : existing industrial areas.

CROS : area occupied by the 'clover leaf' freeway intersection.

CANL : Suarez Canal.

POOL : widening the canal.

COMI : existing shopping facility.

H1.., H2.., H3.., H4.., H5.., H6.., H8.., : are small usesurfaces which, when connected with VISUAL
ACCESS simulate the area taken by the existing freeways.

Note: In further photographs the roads were filled white to make them easier to read.

EX1, EX2., EX3.,
EX4. : exits to the areas surrounding the site.
AIRP : airport.

Areas to be added during the development of Finca La Marina.
RES1, RES2 : residential areas.
IND3, IND4, IND5
IND6 : industrial areas.
CEN1, CEN2 : central area.
SECI : secondary school.
PARK : recreation park.
RD.1, RD.2, RD.3,
RD.4, RD.5, RD.6,
RD.7 : small usesurfaces used to simulate the roads.
What were the constraints operating at the time the Second Stage was recorded?

Roads are simulated with small usesurfaces the width of the road, and constrained with visual access between them to keep other usesurfaces from being located on the road. The loop road was described by four small usesurfaces:

RD.1 Constrained to be 100 m from the POOL and 100 m from the CANL, to allow residential development along the canal and widening of the canal.

RD.2 Constrained to be at 150 m from RSD2, the existing residential development, to allow for an industrial area along the freeway.

RD.3 Constrained to be at 150 m from EX.2, the underpass under future freeway at the south of the site, to allow for an industrial area along the freeway.

RD.4 Constrained to be at 100 m from the POOL (name given for a widening in the canal, to allow residential development along the canal widening.)

RD.1 and RD.2 were constrained to be alligned.

RD.3 and RD.4 were also constrained to be alligned.

RES1, the first new residential area, was specified to be deformable and constrained to be 20 ha.
CEN1, the first part of the central area, was specified to be transparent, and constrained to be 1 ha in area.

IND3, the first new industry, was specified to be a lot of 150x150 m.

CEN1 was constrained to be at 100 to 150 m from CANL (the canal) to be 800 to 950 m from LAGI, the first usesurface used to represent the San Jose Lagoon.

CEN1 and RD.1 were constrained with proximity.

RES1 was constrained to be co-linear with CEN1 and IND3.

RES1 was constrained to be at 150 m from IND3.

IND3 was constrained to be co-linear with H5 and EX2, the small usesurface simulating the freeway on the south side of the site. All small usesurfaces used to simulate existing freeways are linked with visual access.

IND3 was also constrained to be at 100 m from EX2, to leave space for the freeway access and exit ramps.
RESULTS OF THE SIMULATION OF THE GROWTH OF FINCA LA MARINA WITH THE IMAGE SYSTEM.
These photographs were taken directly from the cathode ray storage tube, but were printed negative to cut down costs. (A positive is printed on page 88.)
First stage simulated with the IMAGE system: detail, the loop road
First stage simulated with the IMAGE system,
development from year 3 till 5.
Second stage simulated with the IMAGE system, development from year 5 till 7.
The work environment of the IMAGE system: 3 cathode ray storage tubes, and a keyboard connected to an IBM 360/67 computer through a CP/CMS time sharing system. The lower left hand corner screen is used to display the verbal interface with the IMAGE system. The two other screens display alternate solutions generated by the system, making it possible to compare consecutive solutions without having to record them photographically.
TRANSLATION OF THE RESULTS OBTAINED FROM THE IMAGE SYSTEM IN CONVENTIONAL GRAPHICS.
FINCA LA MARINA, SAN JUAN

Fig. 29

HOUSING, LOW DENSITY
HOUSING, HIGH DENSITY
CENTRAL AREA
INDUSTRY
LAKE OR RIVER
GREEN - OPEN SPACE
PRIMARY SCHOOL
SECONDARY SCHOOL
NEW ROAD
EXISTING ROAD
RAILROAD
LINE DELIMITING THE LAND USES CREATED DURING THE PERIOD DESCRIBED IN THIS DRAWING

FIRST BUS LOOP

SAN JUAN AIRPORT

EXISTING BUS TERMINAL
FINCA LA MARINA, SAN JUAN

Fig. 30

HOUSING, LOW DENSITY
HOUSING, HIGH DENSITY
CENTRAL AREA
INDUSTRY
LAKE OR RIVER
GREEN - OPEN SPACE
PRIMARY SCHOOL
SECONDARY SCHOOL
NEW ROAD
EXISTING ROAD
RAILROAD

LINE DELIMITING THE LANDUSES CREATED DURING THE PERIOD DESCRIBED IN THIS DRAWING

DEVELOPMENT FROM YEAR 3 'TILL 5
FINCA LA MARINA, SAN JUAN

- HOUSING, LOW DENSITY
- HOUSING, HIGH DENSITY
- CENTRAL AREA
- INDUSTRY
- LAKE OR RIVER
- GREEN - OPEN SPACE
- PRIMARY SCHOOL
- SECONDARY SCHOOL
- NEW ROAD
- EXISTING ROAD
- RAILROAD
- LINE DELIMITING THE LANDUSES CREATED DURING THE PERIOD DESCRIBED IN THIS DRAWING

DEVELOPMENT FROM YEAR 5 'TILL 7
CONTINUATION OF THE SIMULATION WITH CONVENTIONAL METHODS.
FINCA LA MARINA, SAN JUAN

HOUSING, LOW DENSITY
HOUSING, HIGH DENSITY
CENTRAL AREA
INDUSTRY
LAKE OR RIVER
GREEN - OPEN SPACE
PRIMARY SCHOOL
SECONDARY SCHOOL
NEW ROAD
EXISTING ROAD
RAILROAD
LINE DELIMITING THE LANDUSES CREATED DURING THE PERIOD DESCRIBED IN THIS DRAWING

DEVELOPMENT FROM YEAR 7 'TILL 9
FINCA LA MARINA, SAN JUAN

HOUSING, LOW DENSITY
HOUSING, HIGH DENSITY
CENTRAL AREA
INDUSTRY
LAKE OR RIVER
GREEN - OPEN SPACE
PRIMARY SCHOOL
SECONDARY SCHOOL
NEW ROAD
EXISTING ROAD
RAILROAD

LINE DELIMITING THE LANDUSES CREATED DURING THE PERIOD DESCRIBED IN THIS DRAWING

DEVELOPMENT FROM YEAR 9 'TILL 11
FINCA LA MARINA, SAN JUAN

HOUSING, LOW DENSITY
HOUSING, HIGH DENSITY
CENTRAL AREA
INDUSTRY
LAKE OR RIVER
GREEN-OPEN SPACE
PRIMARY SCHOOL
SECONDARY SCHOOL
NEW ROAD
EXISTING ROAD
RAILROAD

LINE DELIMITING THE LANDUSES CREATED DURING THE PERIOD DESCRIBED IN THIS DRAWING

DEVELOPMENT FROM YEAR 11 'TILL 13
FINCA LA MARINA, SAN JUAN

Fig. 35

HOUSING: LOW DENSITY
HOUSING: HIGH DENSITY
CENTRAL AREA
INDUSTRY
LAKE OR RIVER
GREEN - OPEN SPACE
PRIMARY SCHOOL
SECONDARY SCHOOL
NEW ROAD
EXISTING ROAD
RAILROAD

LINE DELIMITING THE LANDUSES CREATED DURING THE PERIOD DESCRIBED IN THIS DRAWING

DEVELOPMENT FROM YEAR 13 'TILL 15
The IMAGE system has the property of generating alternative solutions for problems that are loosely under or overconstrained. The only alternative solutions generated in the Finca La Marina study were due to understatement of the problem. A good example of this was the location of RD.1 and RD.4 on the wrong side of CANAL with no alternative solutions offered. IMAGE was thus not used to its full capacity, either through misuse, or because it is unsuitable for this type of problem. Much reading and research was done in connection with the growth strategy for Finca La Marina, before and while working with IMAGE. It is possible that too tight a concept was made of the problem to be able to describe it loosely enough for IMAGE to generate alternatives. When a problem is uniquely constrained there is no need for a machine generated solution if one knows that they are unique sets. But we were unaware that IMAGE would be of little help in this particular instance until it failed to produce alternatives. It is almost certain that the availability of conditional restraints would have been useful in exposing and mitigating the unconscious single-mindedness of the author.

It is possible that IMAGE users without architecture or planning background could be more open minded in the description of a problem; that is, they would have no preconceived solution in mind while setting up the problem. But it is almost certain that if they had studied the problem before using IMAGE, they would have strong convictions about the range of possible
solutions. These strong convictions are partly due to the analyzed information, and partly to the personality and background of the individual involved. In order to specify a problem on the IMAGE system, one must be able to articulate the required relationship and constraints. To achieve this, the designer must have a form concept, and there is a danger that this concept might become too rigid or that the designer would be completely satisfied with it.

From this point several things can happen:

1) The designer can uniquely constrain the problem, and IMAGE will produce the only solution possible under that set of constraints, and no other.

Then the designer can do three things:

a) He can change his mind and get a whole new concept of the problem.

b) He can accept the solution as the only possible.

c) He can loosen up the network of constraints that define his problem and thus allow the IMAGE system to generate alternative solutions.

2) The designer can constrain his problem so that alternatives can be generated by IMAGE.

Two kinds of reactions can be expected from the designer:

a) He can accept the alternative solutions for what they are and compare them with his original concept.

b) He can reject all the solutions that are not similar to the one he made up while specifying the problem.
Could it be true not only that humans are not able to produce many alternatives to a problem, but also that they are not able to accept alternative solutions when they are in a position to generate them by an outside mechanism?
CONCLUSIONS

At the outset of this thesis, it was thought that a growth strategy could be built up without having a finished site plan. During the use of the IMAGE system it became clear that even if no actual site plan existed, one always had a definite concept of a plan in mind. This led to an understanding of why it seemed difficult to devise alternative growth strategies: they are very dependent on the concept of the development.

Only other concepts could have allowed for other growth strategies. Other concepts could have been, for example, not to provide industry with a site, or to create several smaller central areas throughout the site. Even so, these other concepts would not have produced very divergent growth strategies because they are very dependent on the existing conditions on and around the site when development takes place.

We realized that no growth strategy can be devised without a site plan, and no site plan without a growth strategy.
A constant interaction is needed between site plan and growth strategy.
1) SELF-SUFFICIENCY: The creation of a self-sufficient section of the city from the beginning; the location of residential, industrial and central areas close to each other as possible within the site; the arrangement of the proportional size and distribution of the landuses to encourage self-sufficiency at each stage of the development.

2) FREEDOM FROM ANNOYANCE OF CARS: Creation of an environment that is free of the annoyance of automobiles throughout its development.

3) LOW INCOME HOUSING: Location of low income housing in the most advantageous sections of the site. No factor in the growth strategy formulated here would prevent the satisfaction of this goal, but the decision would fall to the architectural designers of the individual subdivisions.
DISCUSSION OF THE COST OF THE FIRST STAGE

A guarantee of up to fifty million dollars in federal funds was available under the New Communities Act of 1970 to start the development of Finca La Marina. This is an approximate calculation, and was computed only to provide an idea of the magnitude of the first stage.

1) There are 95.5 ha of land to be overloaded in order to stabilize it.
   (To overload is to compact a loose soil by loading it with sand or gravel.) Cost of the process is $12/m², and for 955,000 m² amounts to ....... $11.46 M

2) A central area of 1 ha to be built with average building height of three levels, at $150/m² .......................... $ 4.5 M

3) 8 ha of residential area, or 720 dwellings at $20,000 each .................. $14.4 M

4) Parking garages to provide 1.5 spaces per household, at $2,500 a piece.
   Cost for 6,840 dwellings ........................................... $ 2.565 M

   TOTAL ................ $32,925 M

TOTAL
What the cost of roads, open spaces, schools, etc, for this stage will be is not known. A further, more accurate estimation of the cost of this type of development is beyond the concern of this thesis.
RELATION OF EACH DEVELOPMENT STEP AND THE AVAILABLE LABOUR TO BUILD IT

In Thamesmead the difficulty of building up a labour force made it necessary to cut down the development steps drastically. We tried to find how this constraint would affect the step in the development of Finca La Marina. (The data quoted can be found in ref. AH, pp. 64 and 132.)

For 701,000 people employed in 1968 in Puerto Rico, 70,000 were said to be used in "Construction". If this number contains industrial and public works construction, probably only half that number are employed in housing construction. This seems to correlate approximately with the figure of 20,558 new dwelling units built in Puerto Rico in 1968.

We think that one could use the following rule of thumb for determining the number of workers needed to build a housing development: one needs 1,000 to 2,500 men to finish 1,000 dwellings in a year. In the case of Thamesmead, the use of industrialized building methods would have reduced this figure to 800 men. What part of this labour force could be recruited for this project is difficult to determine, but it is certain that building workers must be available in the area, since in 1968, 2,889 new dwelling units (14% of all new dwellings built in Puerto Rico) were built in the Municipality of Carolina. Finca La Marina is situated in this municipality.

Before making the scheduling of a development, the availability of labour should be studied in detail.
DEFENSE OF THE GOAL TO CREATE ALTERNATIVES TO THE USE OF PRIVATE CARS WITHIN THE SITE

The decision to encourage trips within the site by foot or public transportation, and to discourage the use of private cars for that purpose, is obviously very controversial.

To achieve this goal, it is believed that walking and the use of public transportation have to be made more attractive and that the use of the private car must be made less attractive for short trips. Many people will protest that we are imposing our own values upon the future inhabitants of the "Finca La Marina" site. But did we not begin by imposing our values upon them a long time ago? Operation Bootstrap made Puerto Rico one of the most industrialized countries in Latin America. An increased purchasing power and an urban environment made it easy to softsell the "western way of life" to the Puerto Rican people. One of the attributes of this way of life is the private car, and one of the reasons it was so easy to convince the people of the need for a private car, is that it fits in very well with a facet of their vanishing culture. Part of the Spanish culture is for a man to be "muy macho" (very male, or virile). In all of Central and South America, and also in the Caribbean, part of being macho is to have a big shiny car. The car is, of course, also a status symbol for the whole family. In Puerto Rico people tend to use their car for every excuse they can find. Once the car is bought, it is used to justify its
purchase. Many families in Puerto Rico are becoming wealthy enough to be convinced that owning one car is not enough. But the cars that are so attractive to the Puerto Ricans are a nuisance in many ways.

1) **They take up a lot of land.**

   When they are in use they need wide strips of land for roads. But most of the time cars are off the roads, in parking spaces, where they rust and depreciate. A car needs 35 m² to be parked on a ground level parking lot. Given a dwelling floor area of 105 m², as soon as one lives in a building more than three stories high, one's car takes up more ground space than one's house. Parking lots are bare, dirty, and usually disrupt the flow of green and open spaces between the buildings. Parking buildings are bulky and expensive if built as separate buildings, away from the residences. This is a very unimaginative solution, since they could both be integrated in one building, either by vertical or horizontal juxtaposition.

2) **Cars are a safety hazard.**

   The most lethal accidents are between pedestrians and cars, during head on collisions, or collisions due to a failure to yield right of way. The gridiron street pattern is most likely to produce these accidents.

3) **They pollute the air.**

   They produce more noxious gases per mile and per hour during short trips and at low speeds than when they are operating at high speeds and on longer trips.
4) They produce a lot of noise, in fact, the largest portion of acoustical energy generated in a city. To build tall buildings on both sides of a noise source gives the noise a chance to reflect back and forth between them. In this way, the noise level in these buildings will be very high. The acoustical energy level decreases as $\frac{1}{d^2}$ over the distance. It is better that people live as far away from the main arteries as possible. This is why the highest buildings and the highest densities should be the farthest away from through traffic. It should be clear that the private car has no advantages for short trips in an urban environment. There seems to be no strong argument against proposing and implementing a palliative for a problem which we introduced earlier.

PROPOSALS TO ALLEVIATE THE PROBLEM OF THE PRIVATE CAR IN FINCA LA MARINA

1) The integration of residences and parking garages
   Although this will demand innovative architectural design, there are already enough examples of such an integration around the world to provide design standards.
   Advantage: It will leave more area between the buildings to be used as green and play areas.
   The use of the car for short trips will become less attractive.

2) The integration of central areas and parking garages
   This is becoming common practice in most urban areas of the industrialized world.
Advantage: It will bring the residences closer to the central area by avoiding the creation of a "parking desert" such as the ones that can be observed around suburban shopping centres.

3) Creation of a "one way loop road" system on the southern section of the site

The loop road is planned so that no dwelling is at more than 200 meters from it. It is planned to allow only one-way traffic, to reduce the number and the severity of accidents. The one-way traffic system is also meant to make local circulation by private car less attractive than it would be in a conventional road system. This road system would give the opportunity to provide the site with its own "people mover" system. We thought of small buses with curb level floors for easy entrance and exit. The road loop is only 4 kilometers long. If the bus circles at an average speed of 20 kilometers an hour, two buses could provide service at any point every 6 minutes. This bus system would primarily connect the residential areas with the industries, and with the central area.
FINCA LA MARINA, SAN JUAN

- One Way Loop Road

- Housing, Low Density
- Housing, High Density
- Central Area
- Industry
- Lake or River
- Green - Open Space
- Primary School
- Secondary School
- New Road
- Existing Road
- Railroad

Line delimiting the landuses created during the period described in this drawing.
ANNOTATED BIBLIOGRAPHY.
ABRAMS Charles

REPORT ON RESOLUTION P-147 OF THE PUERTO RICO PLANNING BOARD TO THE COLLEGE OF ENGINEERS, ARCHITECTS AND SURVEYORS, 1962.

Contents:
A report on the effect of the issuance of the "Resolution P-147) by the Puerto Rico Planning Board.
He explains briefly why the Planning Board made the decision to delay the approval of a large number of residential developments until it had set up rules for future homebuilding: bad planning, design, and amenities.
He then lists the main "guidelines" of the Resolution P-147, and he comments them. THESE GUIDELINES ARE IN FACT PLANNING REGULATIONS. They prescribe, for instance, that the developer of a residential area must provide land for basic services.
Then he lists all the objections voiced by the building lobby, and analyses them one by one. Some of the objections were: unlawfulness of the Board's action, excessive cost of the improvements to the builder, excessive costs to the consumer, etc. His conclusion is that the requirements of the Board are salutary, that it is not too great a burden on the developers, and that, in the long run, it will contribute to the people's good.

ARCHITECTURAL DESIGN, November 1969, p. 585.
COLUMBIA, U.S.A.

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VALLINGBY, The New Section of Stockholm

Contents:
A number of photographs and plans describing the new settlement in Vällingby. The text is short and deals only with the general characteristics. The text is made more for architects than for planners, it describes primarily architectural features of the new community.
BRESEE Gerald, Editor

THE CITY IN NEWLY DEVELOPING COUNTRIES, Readings on Urbanism and Urbanisation

Contents:
A set of very interesting papers, both theoretical and factual. The general subtitles are:
1. World population changes
2. Urbanisation in major geographic regions
3. The changing role of the city
4. The inhabitants
5. The developing city
This book has information of most developing areas in the world today and references to the past.
It has quite some information on China and a valuable comparison between Leopoldville and Lagos. It has also an interesting paper by John Turner about squatter settlements, especially because of its valuable cross-references and bibliographies.

CAMINOS Horacio, GOETHERT Reinhard

PRE-APPLICATION PROPOSAL FOR GUARANTEE ASSISTANCE UNDER TITLE VII OF THE HOUSING AND URBAN DEVELOPMENT ACT OF 1970
Unpublished preliminary draft, 1971

Contents:
All the basic data on the site, criteria to be used for the development, and a rough sketch of a site plan. At the end the issues of flexibility for meeting future demands and of a planned expressway crossing the site are briefly discussed.
THE URBAN AMBIENCE: A Study of San Juan, Puerto Rico

A Social Science Research Center Study; College of Social Science, University of Puerto Rico, 1964.

Contents:

Chapter 1: Characteristics of the city, its ecological history, and its relation to Spanish and North American Models.

Chapter 2: examines the ecological zones of the urban area in some detail.

Chapter 3: discusses the barrios into which the city is conventionally divided and then introduces the neighborhoods that constitute the principle sample.

Appendix to Chapter 3: provides a good deal of information about these neighborhoods by means of photographs, impressionistic observations, and charts of their interaction networks.

4 next chapters: are devoted to the analysis of several types of neighborhood data: the correlates of interaction, the relationship between intensity and extensity of neighboring, the basis on which neighbors choose each other for interaction, and the conditions that determine residential satisfaction and stability.

Last Chapter: discusses the application of these findings to the current problems of city planning in San Juan.

Note: An interesting document is translated in this book on pages 26 to 29, THE ROYAL ORDINANCES FOR THE LAYING OUT OF NEW CITIES, TOWNS, OR VILLAGES, by the King of Spain and the Indies, in 1573. They are very striking and very interesting planning stipulations.
Aspects of Urban Growth described:

**Economic variables:**
- economic integration of the area (analysis of retail and wholesale trade, commodity flows and telephone calls)
- labour mobility and migration
- change in agricultural activities

**Socio-political variables:**
- adaptation to urban life for a newcomer
- family, neighbour, community relations
- community formation
- needs of people in urban areas, what their preferences are, priorities, how much they are willing to pay for each advantage.

**Public policies and patterns of development:**
- land development variables
- factors influencing land development
- growth alternatives and dev. policies, utility, transportation, zoning policies.

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**COMMONWEALTH OF PUERTO RICO**

**STATISTICAL YEARBOOK, PUERTO RICO, 1968**

Contents:
Statistics about population, demography, climate and altitude, public health, crime, education, labour force and employment, agriculture, industry and services, construction of housing, transportation, tourism, banking, and external trade.

Critic: This publication gives only absolute numbers, no growth percentages, and no graphical representation. But often the figures for 1968 are compared with the figures of the preceding years.
COMMONWEALTH OF PUERTO RICO, OFFICE OF THE GOVERNOR, PUERTO RICO PLANNING BOARD

SAN JUAN, CHOICES FOR CHANGE, 1967

Contents:
An introduction and basic data on urban growth in San Juan, followed by the plans of four alternatives for the further development of the San Juan metropolitan area. At the end, there is a comparison of 4 alternatives. This report is written for a general public and is for that reason superficial.

CREESE L. Walter, Editor

THE LEGACY OF RAYMOND UNWIN: A HUMAN PATTERN FOR PLANNING

The M.I.T. Press, Cambridge, Massachusetts, 1967

Contents:
A biography of Raymond Unwin through his work and his writings. It contains 10 of his most famous papers. For instance: "Nothing gained by overcrowding; how the Garden City type of development may benefit both owner and occupier", and "Higher building in relation to town planning", about the effects of highrise buildings on city life and circulation.
It is a basic reference book for planning history and even for planning theory.

CUMBERNAULD, EAST KILBRIDE, GLENROTHES, AND LIGINGSTON DEVELOPMENT CORPORATIONS

REPORTS FOR THE YEAR ENDED 31ST MARCH, 1966

Edinburgh, Her Majesty's Stationery Office

Contents:
Report on the state of the four new towns at that time. Plan of the new towns, balance sheets of the financing, account of problems that occurred. Most of these problems seem to be keeping synchronisation between the development of residential, commercial, and industrial activities.
DE SOISSONS Louis
WELWYN GARDEN CITY NEW TOWN: The Report of the Welwyn Garden City Development Corp. 1949

Contents:
The original version of the city plan of both Hatfield and Welwyn Garden City. Some good aerial photographs of the City in its first developments. Text gives figures and detail of the different landuses within the City. Everything included in today's New Towns is already present in the specs for this town. But only the goals are expressed and unfortunately not the ways to implement them. Almost nothing is said about how people are going to move around in the City. Nowhere in the text are cars spoken about. A bus system is planned however.

DONNELLY G. Thomas, CHAPIN F. Stuart, WEISS F. Shirley
A PROBABILISTIC MODEL FOR RESIDENTIAL GROWTH
Institute for Research in Social Science, University of North Carolina, 1964.

Contents:
A description of a synthesis model for the city of Greensboro in North Carolina (cfr. CHAPIN and WEISS: Urban Growth Dynamics).
The model simulates residential growth as follows:
1. The computer finds the land units that are unsuitable for residential development and withdraws them from the market.
2. Measures the relative value of each land unit.
3. Calculates effects of public improvements and changes in employment opportunities on the value of land units for residential development.
4. Reassesses total value (attractiveness) of land units considering initial value and adjustments of value caused by effects calculated in § 3.
5. Density constraints regulate allocation of families in geographical patterns.
6. House holds (family) in market are allocated on a probabilistic basis.
A general description of the plans for the development of what later was called the Thamesmead project.

The plans of the whole site have been changed since. They seem very rigid and tied to too much orthogonalism. This publication contains also the plans of the first neighbourhood that was built: the south-west sector. It has a very clear plan and a strong dominating architecture. Traffic segregation is complete and a great deal of the pedestrian traffic is kept on decks above the parking and garages which are on ground level. This concept was widely publicised, and this neighbourhood appeared in all architectural magazines between 1967 and 1970, partly because of its clever perspectives and renderings. The whole pamphlet is made for a general public and contains more artistic impressions than hard data.

A preface by F. J. Osborn and an introductory essay by Lewis Mumford. Then follows the well known text of Ebenezer Howard. It is much more the presentation of an ideal socio-economic study than a mere planning recipe. The text is also quite polemical and quotes and replies to articles and books which were well known around 1898 but completely unknown now.

An account of the influence of the work of Capability Brown and Humphry Repton on
the English landscape today, their lives, business and techniques. This book is interesting because it describes the clichés that they used and that planners still use now. For example: the constant use of a copse of trees on the top of an otherwise bare hill. A good example of their art is said to be Blenheim castle. Brown transformed many swamps through drainage into lakes and parks. Brown, Kent, Repton worked in a unique period when landowners had the sufficient wealth and leisure to take an interest in the appearance of their estates, while possessing the power to remake vast tracts of countryside without asking anyone's permission. Even villages could be removed if this seemed necessary. It would be very interesting to analyze the influence of eighteenth century landscaping on the landscaping of contemporary landscaping, especially in the New Towns.


IN POSSESSION OF PROF. H. CAMINOS M.I.T.

JONATHAN DEVELOPMENT CORPORATION, Chaska, Minnesota

JONATHAN NEW TOWN: DESIGN AND DEVELOPMENT 1971

Contents: A very vague and probably intentionally incomplete and inaccurate publication. What they print in their design concept section is inconsistent with what is represented in the "General Development Plan". JONATHAN NEW TOWN is going to have an end population of 50,000 inhabitants on a 8,000 acre site (3,240 ha). The New Town is situated WSW of the Minneapolis-St. Paul Metropolitan area. About growth programming, very little: "Inputs for determining the feasible size of various functions are very necessary in the preliminary phase of conceptualizing the physical relationships of the plan, they are received from land use and marketability studies for commercial and industrial uses, population and economic projections, and an estimate of the potential attraction of the final product. The process of programming as part of the design process must necessarily be an ongoing process of upgrading and changing quantities as these factors change over time. It is also, however, a cumulative process, in which each decision is based as well on previous decisions and commitments. Therefore the identification of crucial primary decisions and the preliminary estimate of size for each of these areas is a major input to the urban design concept". This is the only thing said about that question (p. 29).

Out of the Land-use Summary one can guess that there is a large amount of industrial
development, that there is residential, commercial, and church development but no educational development during the first year. That comes only during the second year. There is a large increase of educational dev. during the 9th year, and a large increase of commercial (multi-use) dev. during the 10th year. Preservicing does not seem to be the policy in this New Town development (p. 43).

Separate companies (2) have been formed: one for maintenance and farming operations, the other for ownership and management of rental properties (besides the Development Corporation) (p. 7).

From a photograph of a supposed model of the New Town, one could think that the development of the residential areas will be done according to the RADBURN system (p. 3).
A SKETCH OF THE PLANNING-BUILDING PROCESS FOR COLUMBIA, MARYLAND

Contents: A description of the process of acquiring the land for planning and building Columbia New City. It contains also quite detailed plans of the City, and an outline of the design concepts. The article is complete, concise, and worth reading.

THE PLANNING OF A NEW TOWN: Data and design based on a study for a New Town of 100,000 at HOOK, Hampshire, 1961

Contents: This book contains a general description of this new type of new town and the motivation behind it.
1. Selection of the site: the political interactions that led to the choice of the Hook site are not described at all.
2. Main aims of the Town: urban character; easy to understand; compact; urban character in terms of buildings, landscape and the relation between them; central area: a pedestrian meeting place, housing around, served, not dominated by the motor vehicle; car-pedestrian separation: horizontal in most of the town, vertical in the central area where the carparks are covered.
3. The people: study of who and when and how was going to live in Hook New Town.
4. Master Plan
5. Residential areas: description of RADBURN SYSTEM as used in Hook: a distributor road for motor vehicles which feeds cul-de-sac and pure pedestrian circulation inside.
6. Central area: conception and organization.
7. Industry
8. Community services: education, medical and welfare, churches, social activities and recreation.
9. Recreation and open spaces
10. Communications: roads, pedestrian ways, bus routes, railways.
town hall, cinema, theatre, magistrates court, restaurant, church
and telephone exchange. Also more offices.
- industry: two-thirds of the land reserved for that purpose
developed at this stage.
- major roads: completed
- hospital: completed
- stadium: completed
- lakes and open spaces: completed

Note: Interesting table on page 130, Appendix F on what was provided when in the
central areas of English New Towns.

Kevin LYNCH

Informal conversation about the planning and development of Columbia New City.
Date: February 25, 1971
Place: M.I.T., Cambridge, Massachusetts.
11. Engineering services: soil and surface water drainage, sewage disposal, water supply, gas, electricity, phone, district heating, refuse collection and disposal.

12. Costs

13. GROWTH Programming: seems very crude.
   a) Intake Period: in 15 years up to 70,000
   b) Natural Growth Period: at year 50: total of 100,000
   Intake or immigration period subdivided in 3 5-year periods.
   **First 5-year period:**
   1) near converging roads
   2) near existing shopping and other facilities
   3) near bus route to supporting industry
   4) away from railway station (commuting by rail discouraged)
   5) easy sewage (downhill), minimizes first investment.
   **Aim:** ensure a compact town with services from the beginning.
   **To be built:**
   - 5,000 dwellings
     - central facilities with neighbourhood shopping, church, fire and ambulance station, public house, filling station..., market and secondary school
     - industry
     - major roads
     - regional hospital: first stage
     - open spaces and lakes
   **Second 5-year period:**
   **To be built:**
   - dwellings till the level 13,000
     - central area: extended main shopping parade, additional secondary school, technical college, police station, hotel, G.P.O., labour exchange, swimming baths and private offices
     - industry
     - major roads
     - railway and bus station completed
     - hospital: main functions completed
     - open spaces and lakes
   **Third 5-year period:** most important stage, by the 15th year the town should be a complete working entity in every respect while still allowing for natural increase.
   **To be built:**
   - dwellings up to the level of 20,700
     - central area: completed with opening left for future development,
POOLEY Fred

NORTH BUCKS NEW CITY


Contents:
The study and the proposal for a New City of 250,000 inhabitants in Buckshire. The city is designed for a 100% car ownership but with a monorail public transportation for reducing the cost of a 100% car circulation network. There is a good, but slightly tendentious comparison between a city with car circulation alone and one with a mix of car and monorail circulation. It shows a fresh, but somewhat rigid concept of a New City. One can see different inventive uses of monorail loops for serving a large portion of the population, it would allow for instance to group schools together and have them share otherwise expensively duplicated facilities. It would also leave the choice between one great centre and several smaller competing centres. The ideas in this book are very good but the designs are a bit unimaginative and simplistic.

RODWIN Lloyd

ECONOMIC PROBLEMS IN DEVELOPING NEW TOWNS AND EXPANDED TOWNS
(with emphasis on industrial planning and development)

Round the table conference on the planning and development of New Towns, Moscow, 8/64. Organized by the United Nations Bureau of Technical Assistance and the Bureau of Social Affairs, etc.

Contents:
A very interesting paper describing very concisely the history and the evolution of the New Town idea in Britain; and the alternative town expansion programme implemented by the Conservatives. The Rodwin describes other New Town programmes outside Britain, and compares them with the British. Then he analyzes what we can learn from these experiences as far as: financial strategies, timing, scheduling and coordination. The desire to create urbanity, and the programming considerations. In another part he tries to compare the cost of building New Towns versus other forms
of development: he discusses the relative attraction of new towns for labour and industries as compared to the attractions of the large urban areas. He also discusses the dependence of the new towns on the larger metropolitan areas for the marketing of their production. Rodwin then talks about the new towns as instruments for a national policy for Urban Development, and other roles of the new towns such as, the redistribution of population and economic activity, the encouragement of new resource development regions, handling of boom towns, etc. Then follow a few tables listing the names and estimated capital expenditure of most New Towns in the world.

THE ROUSE COMPANY

A REPORT TO THE CITY OF NEW YORK

AN ANALYSIS OF DEVELOPMENT TRENDS AND PROJECTIONS AND RECOMMENDATIONS FOR A NEW CITY IN SOUTH RICHMOND (STATEN ISLAND), 1970

A very detailed study of a strategy for the development of the south part of Staten Island. It is basically a report that should have as result the creation of a public corporation for the development of South Richmond. This report was also designed to obtain the advantage of creating legislation tailored as closely as possible to the needs and opportunities of South Richmond.

This report contains:
1. Planning and development goals to guide the growth of South Richmond
2. Major physical and economic factors influencing development
3. Development alternatives: low, middle, high density, ...
4. Economic analysis
5. Evaluation of the planning alternatives
6. Strategy for implementation

This report is very context connected, is very much connected with the political situation of New York. Nowhere in the report can one see how and where the different ethnic groups are going to be located, separated or integrated. The financial study seems very impressive but difficult to control since the models used for the calculations are not listed or even described.

To me the Rouse Company seems to be taking a monopoly on residential development in South Richmond, with the excuse of creating a new city.

**FUTURE HIGHWAYS AND URBAN GROWTH**

Under Commission from the AUTOMOBILE MANUFACTURERS ASSOCIATION, 1961

Contents:
The book says to be a comprehensive study of the National System of Interstate and Defense Highways as it relates to future travel requirements and the changing shape of Metropolitan America. This book professes that building Highways is good for everything in the country. It tries to prove it with a few examples and a lot of charts. Page 320: "Benefits to National Defense: The National System of Interstate and Defense Highways is vital to national defense for mobility of manpower, supplies, and weapons. Interstate highways are relatively invulnerable to attack, and could likely assist in evacuating people from cities and in transporting medical supplies and disaster personnel. During periods of national emergency, highways have become extensions of production lines. For example, during World War II, 60% of all outbound tonnage from defense plants was road-borne. Similarly, many raw materials and component parts were delivered by truck." Typical!

STEIN S. Clarence

**TOWARDS NEW TOWNS FOR AMERICA**

The M.I.T. Press, Cambridge, Massachusetts, 1966

Contents:
1. A very personal introduction by Lewis Mumford about the personality and the work of Clarence S. Stein and Henry Wright.
2. A very detailed account of his work by Clarence Stein. He describes in detail the designs of Sunnyside Gardens, New York, and RADBURN, New Jersey; but also the designs for the Greenbelt New Towns which in fact are almost not New Towns at all, they are only well serviced villages without any employment opportunity. It is all together an interesting book; it gives an idea of how poor planning in the U.S. is in tradition and in valuable examples.
THE PEOPLE OF PUERTO RICO
A study in Social Anthropology

University of Illinois Press, Urbana, 1956

Contents:
A very complete study of the social characteristics of the people of Puerto Rico. It deals mainly with the rural communities. There are different studies on the subcultures of tobacco, coffee, and sugar plantations. This is followed by a comparative analysis of the different subcultures and a tentative of theory formulation on cultural change.
This book contains also an extensive study of the history of Puerto Rico since its discovery by the Spanish. This history is used to show the change in agriculture because of the new markets created by colonization.
This book has now only historical value because the agriculture in Puerto Rico is rapidly making place for manufacture. In 1968 only 91 out of the 701 thousand people employed were employed in agriculture (Source: Anuario Estadistico, Puerto Rico, 1968). But this thick book contains a record of a rapidly disappearing rural culture, with a lot of crispy details.

UNIVERSAL NATIONS, ECONOMIC COMMISSION FOR EUROPE

THE FUTURE PATTERN AND FORMS OF URBAN SETTLEMENTS

The proceedings of the seminar organized by the Committee on Housing of the United Nations Economic Commission for Europe held in the Netherlands, September 1966.

U.N. Publication Number ST/ECE/HOU/28 vol. 1, 2, & 3.

Contents:
Volume 1: A number of papers about change in the European urban settlements, mostly about the U.S.S.R., The Netherlands, Poland, Czechoslovakia, France, U.K., with examples of U.S. cases.
The discussed topics are:
1. Demographic, economic and social changes
2. Technological changes
3. Changes in public administration
4. Changes in traffic and transport

Volume 2: Case studies on the pattern and form of new urban settlements. Discussed are large-scale town extensions in Sweden, West Germany, Yugoslavia, France, Israel, USSR, United Kingdom.

This paper contains very interesting plans of USSR new towns. One of the plans shows how the new town was supposed to grow.

Volume 3: Survey of previous United Nations meetings on urban problems and policies, by the Secretariat of the Economic Commission for Europe.

POPULATION AND URBANISATION TRENDS: A STATISTICAL SURVEY
Contains tables and maps and charts of world population, by major area, country, also density, urban population, of past and projections, degree and concentration of urbanisation structure of economically active population in Europe.

WEISS F. Sherley, SMITH E. John, KAISER J. Edward, and KENNEY B. Kenneth

RESIDENTIAL DEVELOPER DECISIONS, a focused view of urban growth process
Institute for Research in Social Science, University of North Carolina, 1966.

Contents:
This paper contains a model for locational decision of land developers. The model maximizes profit for the developer taking into account inputs (purchased land + development cost), output (lot available to the consumer), parameters and constraints. These are influenced by three sets of decision factors: 1) site characteristics, 2) decision agent characteristics (type of developer, type of landowner, type of consumer), 3) contextual (socio-economic and public policy factors).

Good analysis of development decision factors.

Five states of land: 1) urban interest
2) active consideration for development
3) programmed for development
4) active development
5) residence
Contents:
The plans of the states of development of Thamesmead London, from 1967 to 1981. It contains also some bar charts figuring capital expenditure, manpower use, population, employment, for each year of development.