march 19-20 2009

The PhD Seminar on

# PUBLIC SPACE

Delft, The Nederlands

Workshop 2 – Public Space Interventions

## Modelling Costs and Quality of Housing Units and Public Spaces for Improving Public-Private Collaboration in new Residential Developments

Prof.Dr.Ir.Arch. Alina Delgado

www.urbanism.nl

TU Delft Delft University of Technology

Challenge the future

**ALINA DELGADO**
**MSc Arch- Researcher**
**FRANK DE TROYER**
**Prof. Dr. Ir.Arch**
**KATHOLIEKE UNIVERSITEIT LEUVEN**
**Departement Architectuur, Stedenbouw en Ruimtelijke Ordening (ASRO)**
**Kasteelpark Arenberg, 1**
**3001 Leuven (Heverlee)**
**Belgium**
**tel +32 (0)16-32 13 96 - +32 (0)16-32 13 72**
**fax +32 (0)16-32 19 84**
**alina.delgadobohorquez@asro.kuleuven.be**
**Frank.DeTroyer@asro.kuleuven.be**
**http://www.asro.kuleuven.be/Design_and_Building_Methodology**

# MODELLING COSTS AND QUALITY OF HOUSING UNITS AND PUBLIC SPACES FOR IMPROVING PUBLIC-PRIVATE COLLABORATION IN NEW RESIDENTIAL DEVELOPMENTS – Case Guayaquil, Ecuador.

*Over the last 15 years Guayaquil Municipality invested in major urban renewal projects: a new waterfront was built, inner city and main parks reshaped, historical neighbourhoods and sale markets rebuilt, mass transport improved, some informal settlements were regularized and a social housing project started. In 2004 UNDP[1] recognize this activity as a best practice in local development. Nevertheless there is still a great necessity for provision of urban residential developments and basic services. For those major projects collaboration between the public and the private sector will be required in order to mobilise enough funds. The public sector should take care of the quality of the public spaces (streets, squares, parks) and the coherent planning in space and time (location of services and commercial spaces). This will add value to private developments. Private developers should become aware of opportunities to provide a whole range of dwelling types with basic qualities and upgrading and expansion possibilities for a mixture of social groups. A balance between increased costs and better quality should lead to a win-win situation between pubic and private sector. Models are elaborated to simulate different scenario's for developing a range of dwelling types (including cost and qualities leading to a certain market value), for providing infrastructure and public spaces (and by doing so influence market value of privately developed dwelling units), for phasing projects and for comparing different approaches of subsidising new urban developments. The aim of the models is to guide the collaboration between stakeholders in coming to an integrated approach for providing better, more variety, beautiful and feasible urban developments.*

## 1. Introduction

A major challenge for those involved in the proposal of a strategic plan for the urban development of Guayaquil more than one decade ago was the recovery of the city from decay through major urban projects and a regeneration process that would served as a catalyst for capital attraction for further more social projects. The regeneration process of the city started with a major project for the redevelopment of a new waterfront for the city "Malecon 2000", consequently down town was reshaped, historical neighborhoods and whole sale markets rebuilt, massive transport improved.

Furthermore it was implemented the redevelopment of another waterfronts for the city like "Malecon del Salado" projects[2], plus the regeneration of parks and streets and the improvement of garbache recollection and reinforcement of security. Some social measurements were also

[1] UNDP, United Nations Development Programme www.undep.org
[2] Fundacion Malecon 2000, Malecon del Salado Project, www.malecon2000.org
Municipalidad de Guayaquil, www.guayaquil.gov.ec

implemented as a regularization process for informal settlements and social housing projects for citizens recreation, health care and housing. The whole process was even recognized by the UNDP as a best practice in local development.

Nevertheless still significant actions have to be accomplished so that the majority of the population can really improve their quality of life. In fact there is still a huge housing demand for the poorest groups of the population[3], besides the improvement and redevelopment of the existing ones, providing them with a better improved urban environment.

In accordance with M. Tiepolo [4] 70% of the population of Guayaquil still lacks of drinking water, sewerage systems, drainage rainwater system and paved streets; all these increase the risk of diseases especially for children and elderly people. There is at the same time a scarcity of green areas and meeting points for the community living in neighborhood areas, tending this to a desegregation process of social joints and interactions within the communities; besides also of the lack of schools and bus stops located in an appropriate distance from houses.

For the implementation of these major projects collaboration between public and private sectors should be reinforced, public sector and private developers should take care of the public space (green areas, communal services) and for the provision of infrastructure. This will add value to private developers. At the same time private developers should become aware of the opportunities to provide a whole range of housing types and public space within the neighborhood unit in accordance to people's preferences, income ranges and willingness to pay for certain housing quality characteristics. This also will help private developers to maintain profitability levels and the economical sustainability of the whole urban development process.

In this research we look to the housing dwelling in what is related not just with their design and technical characteristics but to the whole urban environment in what it is inserted. The aim of the study is to develop a methodological tool that will help different stakeholders to make appropriate decisions being aware of the consequences of changes in design parameters for the houses, plots and the urban environment.

Cost implications and housing technologies for low income groups had already been analyzed in previous studies about housing studies in Ecuador[5], however little efforts had been made to investigated the willingness to pay of people's preference over the market sales price of a house and the possibility upon this of assuring private contractors a profitability margin that allowed them to provide good quality houses. In fact, defining a good value for money social housing programmes is a question that in this context has neither been posed explicitly nor answered satisfactorily, and relates to try to find the optimal combination of housing characteristics to be provided by the developers at the minimal cost but with an acceptable and desirable quality for the population.

Models are elaborated to analyze the consequences of those changes taking into account people's preferences, as the final users of the houses. For these quality evaluations are undertaken in order to give people houses which are they are not only able but willing to pay for. In order to attempt to accomplish with this objective a combination of different methods

[3] In accordance with estimations made by the Municipality of Guayaquil for the report "Poblacion Ajustada y Proyectada e Informacion del Catastro Urbano" 2005-2008, they calculated this figure based in the Census of population made by INEC in 2001, National Institute of Stadistics and Census, which registered a housing deficit of 189.637 housing units for the year 2000 and they made a projection of 200.000 housing units for the year 2002.

[4] Tiepolo Maurizio, 2007,*The Barrio Marginado Regularization in Guayaquil-Ecuador*, Politecnico di Torino, Working paper no. 27,pp 5

[5] (1) Mirjan Pronk,2007, *Sustainable Building Systems for Low cost housing in Guayaquil-Ecuador*, Unpublished master thesis, Eindhoven University of Technology
(2)Walter Garcia Cedeño, 2006, *Housing for Low Income families in Ecuador*, Working paper, Lund University

will be used, based in a multi-criteria analysis, a point value system for the model and a weighting system based in an Analytic Hierarchic Process – (AHP). In the models a point/value system will be implemented, in order to determine a market value that will be directly influence by decisions taken for design options. This will add an extra value to those houses that at the end will give more benefits to the private and public sector.

The hypothesis of this study is that in order to provide on one hand a better quality of life and affordable housing units for the users and on the other hand to assure private contractors an adequate level of profit a more integrated approach is undertaken, including for this also the participation of public sector for providing infrastructure and basic services and making appropriate urban policies for these urban developments. All this also with the purpose of changing scale levels, from micro-interventions to a more general one for improving quality life and housing demands for the lowest income groups of the population.

## 2. Context

Guayaquil is the economical capital and the most populated city of Ecuador. It is situated on the coast in the south west of Ecuador, 4,6 m. above sea level, 1.7° north latitude and 79.9° west longitude, in the delta formed by the Guayas river and in its way to the Pacific Ocean through the Golf of Guayaquil.

The maximum temperature is 38°, minimum 21° with an average of 28° The relative humidity is 95% and minimum 80%. The annual average of rain is 620 mm. The natural limits of the city are the hills "Cerro Blanco" and "Azul", which are part of the "Bosque seco Tropical" ,the mountain "Chongon Colonche" and the Guayas river which is formed by the joint of the rivers Daule and Babahoyo.

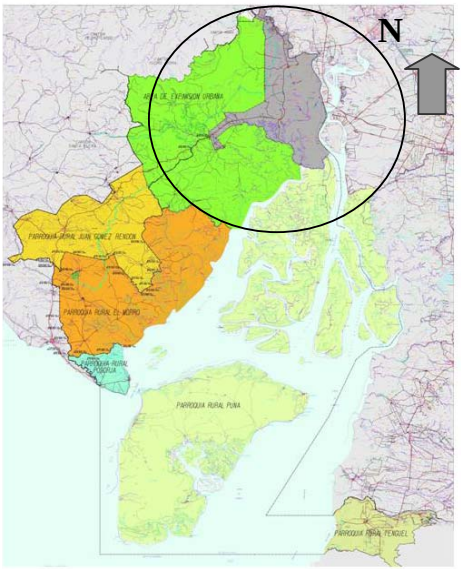


**Fig. no.1**: Guayas Province, 2007, Guayaquil Metropolitan area is encircled.
**Source:** DOIT , Municipality of Guayaquil *(Direccion de Ordenamiento e Infraestructura Territorial)*

Fig. no.1 shows with grey (and encircled) the actual urban area of the city; with green color the area for urban expansion of the city, which correspond to the way to the Coast and the rural cantons of Juan Gomez Rendon, EL Morro, Posorja, Puna y Tengel. Guayaquil has been a very strong pole of attraction for the inhabitants of its surrounding areas and the whole country. Guayaquil concentrates the highest Percentage of urban population in Ecuador, around 81.82% (Infoplan, 2004); this is the reason why the housing problem had intensified in the city. It has a population of 2'037.827 inhabitants[6] .Guayaquil produce more than 25% of the GDP of the country and has an urban area of 34. 449 ha[7]. and a density of around 89 inhab/ha.[8]

[6] INEC. *National Census of Population* .VI Censo de población y V de vivienda 2001, Tablas, www.inec.gov.ec
[7] ha = hectárea = 100 m. x 100 m.
[8] hab = inhabitant; inhab/ha = inhabitant per hectarea

For a better understanding of the city problems is important to consider its very specific location in relation with the high growth rate of population through the history of the city. The lands in which Guayaquil city is located are mainly very flat lands, with the exception of some areas to the North and West spreading on the hilly hinterland and to the Cordillera Chongon-Colonche, as well as on left bank of the Guayas river. The geomorphology of the area is a mix of silt and limestone deposits. The highest point is localized at 460 m in the north –western hilly area . The level of underground water is in some parts of the city it is just about 1 meter under ground. Geomorphology and precipitations highlight the key importance of infrastructure for Guayaquil, which is to date one of the most important issues that city is lacking. Guayaquil's geography puts city at risk during each rainy winter season, the low lands of Guayaquil facilitates floods during rainy season due to a lack of storm water drainage, in addition to the fact that also Guayaquil is affected by the meteorological changes of the tides from the sea, in such a way that for example in the occasion that there is a heavy rain and at the same time the tide of the sea is at its maximum level the rain waters practically have nowhere to go and certainly some areas of the city are going to be flood. [9]

The northern-western hilly parts of the city which is now the home of the new poor neighborhoods and informal settlements do not have the same problem of flooding from the low parts, but rather than alleviate the problems caused by low elevations in other parts of the city, they have their own problems of rain drainage and erosion.[10] The drainage became difficult and stagnant waters brought diseases as dengue in many of these low-income of the city, problems that there are also commonly found in the low parts. Besides in the summer dry seasons, the dried mud of the unpaved streets become dust that is also the reason for diseases for the population as bronquitis and allergies, especially for children. Today the city is spreading to the hilly hinterland as well as to the left bank of the Guayas river.

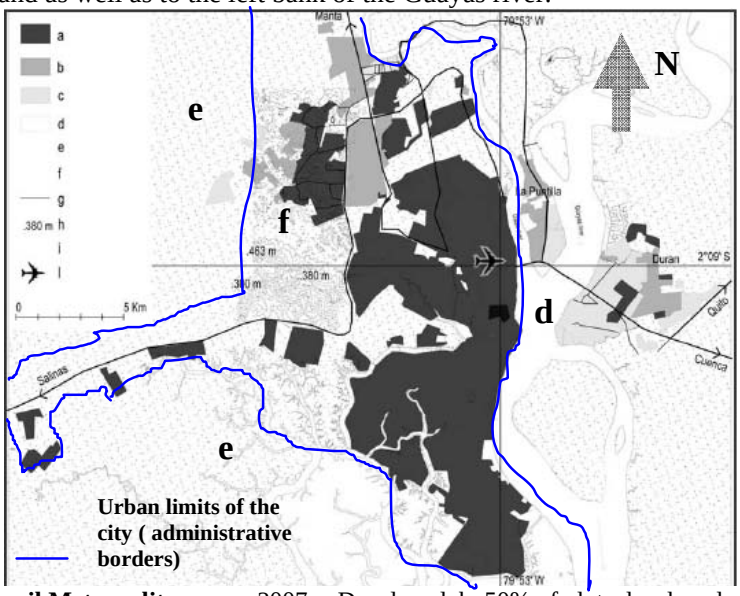


**Fig.2 Guayaquil Metropolitan area**, 2007. a.Developed, b. 50% of plots developed, c. Less than 10% of plots developed, d.Water bodies, e.Mangrove and rural area, f. Hills, g.Main paved roads, h.Height, i. Geographic coordinates, l.Airport.

**Sources:** Cristina Armando outline on MG 2002-2007 satellite image-MaurizioTiepolo, *The barrio Marginado, Guayaquil*. Working paper no.27, 2007, Politecnico de Torino

[9] Emily Joiner, Murky waters, *A critical and purposeful look at water and sanitation services in Guayaquil-Ecuador*, 2007, pp 12-13

[10] Colección LNS. Lugar Natal del Guayas: Estudios Sociales 4 EB, Editorial Don Bosco:Cuenca, Ecuador (1999), pp.19-52)

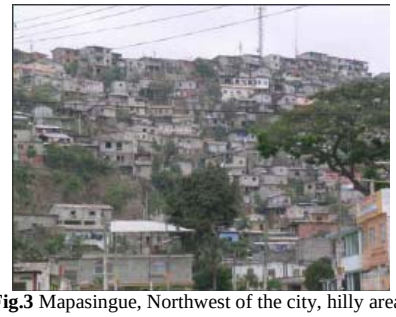

**Fig.3** Mapasingue, Northwest of the city, hilly area, 2006

**Fig- 4**. Ciudadela "Las Orquideas", Northeast of the city, low area, flooding during rainy season, 2009

### 2.1 New areas of development for the city

The urban growth of the city is concentrated around two main roads that function as axis of growing for the city, around the Road to the Coast are located in zone (G) and zone (H).Both are outside of the urban limits of the city. Zone (G)"Future airport" zone is the area designated for future main projects of the city, like the new airport, and has also a high proportion of protected areas; zone (H) Chongon Damp is a protected area as well an area dedicated for extraction uses, quarries, and for the extraction of mineral materials used mainly for the construction sector.
Another important axis for the city is in the North direction, and around the road to Daule are zones (E) and (I). Zone (E) is called "Pascuales", this is inside of the urban borders of the city. To the Northwest of this area and along a main highway "perimetral"[11] that connects to Daule road it is located zone (I) called also the "new city"or "Colina de las Iguanas", and the area of mainly new and vast informal settlements.

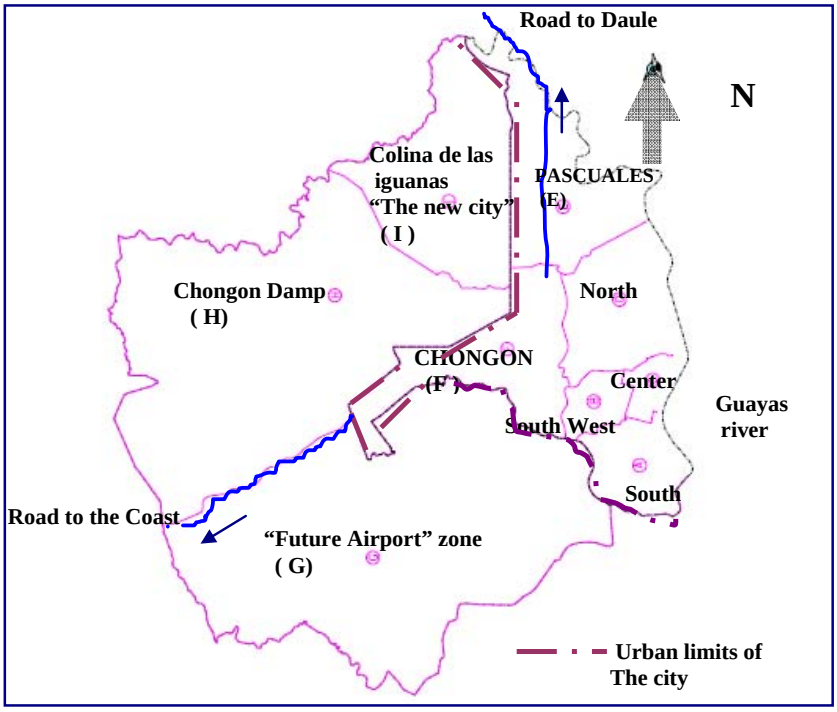


**Fig no5. Planning zones of the city**
**Source:** Municipality of Guayaquil, DOIT, Direccion de Ordenamiento e Infraestructura Territorial, Report " *Poblacion Ajustada y Proyectada e Informacion del CatastroUurbano"-Densidad Neta poblacional y zonas de planificacion, 2005-2008*
***Elaborated by**: The author*

[11] A highway street surrounding Guayaquil (70-90 m. Width).

## 2.2. Actual conditions of life in a peripheral "barrio" of Guayaquil

In order to give a more accurate idea of the actual conditions of life in many urban and suburban areas around the periphery of the Metropolitan area of Guayaquil, a "typical" neighbourhood or "barrio" had been chosen[12]. Fig. no.7 shows a street network corresponding to "Flor de Bastion". This is located in the northern part of the city, in zone I (Colinas de las Iguanas-"New city"), in accordance with the areas or urban development of the city. This *barrio* is located along the *perimetral* and had an estimated population of 56.000 in 1996.

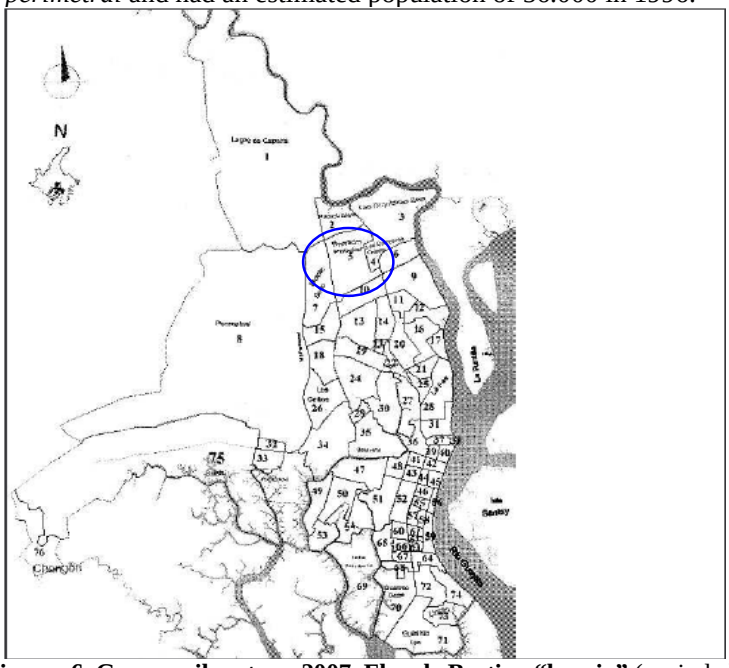


**Fig. no. 6. Guayaquil sectors, 2007, Flor de Bastion "barrio"** (encircled)
**Source**: Municipality of Guayaquil- G. Mera, 2006


**Fig. no.7. The peripheral "barrio" of Guayaquil - Flor de Bastion**

[12] Maurizio Tiepolo, The Barrio marginado, Regularization Process, Guayaquil-Ecuador, working paper no.27, 2007, pag.8

Generally a *barrio* has a regular grid of streets (i.e. north-south oriented), set out indifferently to land gradient, that cuts out rectangular blocs hosting from 20 to 26 building plots. Usually a building plot has surface of 120 m2, (8 x 15). This feature gives an impression of planned development. But very few streets are paved and provided by rain storm drainage. Although electricity is provided and get from most of the dwellers, provision for water disposal and sewage system in not generalized. The barrio holds only dwellings and few commercial activities along the main street, one or more churches and some private schools. Squares and green areas as community life organization centers are unusual. Sports fields and green areas are absent. Other activities as wholesale market, services, health care centers are commonly located outside the *barrio*, along the *perimetral*, the highway street surrounding Guayaquil ( 70-90 mts. Width). A better idea of the under equipment of the *barrios* is analyzing the necessities for community services of "Flor de Bastion" .. According to DOIT,[13] Flor de Bastion should have 21 nurseries, 18 schools and 19 high school, but it had only 1 nursery, 6 schools and 11 high schools. At least 20 health centers should exist in the *barrio* (health centers and sub-centers, hospitals, etc.) but it had only 9. Out of 20 parks and green areas and the 20 police stations and fire departments none existed. Dwellings take the form of bamboo shacks (that testify the presence of new comers) to multiple story concrete houses. The oldest the *barrio*, the lesser the number of available building plots and bamboo shacks.

### 2.3 Deficit of housing in Guayaquil.

The deficit of housing is an indicator of the quality of live of the population give us also an idea of the conditions of the context. Guayaquil is a city with a high deficit of housing, this is estimated from the amount of new houses required to cope with the growing rate of new households and for the necessity of improvements of the old ones.
A total requirement for the year 2008 of 198.466 new housing units was estimated, this total demand of housing was calculated based in the estimations made by the Municipality about the housing deficit in the city of Guayaquil in the years 1990-2000.[14] From this total of housing demand 56.000 new housing units belonged to low income groups of the population.[15]
The main causes for this housing deficit are: high rates of births, the migration to the city, a very low economic capacity of the population, and lack of adequate social housing programmes.

### 2.4 Main planned future housing projects for the city of Guayaquil and average area needed.

Initial programmes promoted by the Municipality and the Government had very little impact in trying to cover with the housing demands of the population. In 2001 the Municipaliy promoted the programme "Mucho Lote" intended for 14.383 dwelling units. This housing programme was one of the main ones launched by the Municipality in the city to try to cope with the housing demand, it was targeted for the low and medium income-low groups of the population, and it is actually implemented and built in an area of 189 has. , with green and communal areas and basic infrastructure. The project is surrounded by main roads and public transportation. Most of the plots have an area of 72 mt2, (6 x 12 m.), for intermediate plots and 7 x 12 for corner plots, considering also commercial plots with mix of functions.

---

[13] DOIT, Direccion the Ordenamiento e Infraestructura Territorial, Municipality of Guayaquil, Minimum regulations for communal services for a neighborhood, from the decree that regulates the urban development type "plots with services"

[14] In accordance with estimations made by the Municipality of Guayaquil for the report "Poblacion Ajustada y Proyectada e Informacion del Catastro Urbano" 2005-2008, based on the Census of population of 2001 made by INEC, National Institute of Statistics and Census.

[15] Based in estimations made by the Municipality of Guayaquil, based on the Census of Population of 2001 made by the INEC, National Institute of Statistics and Census.

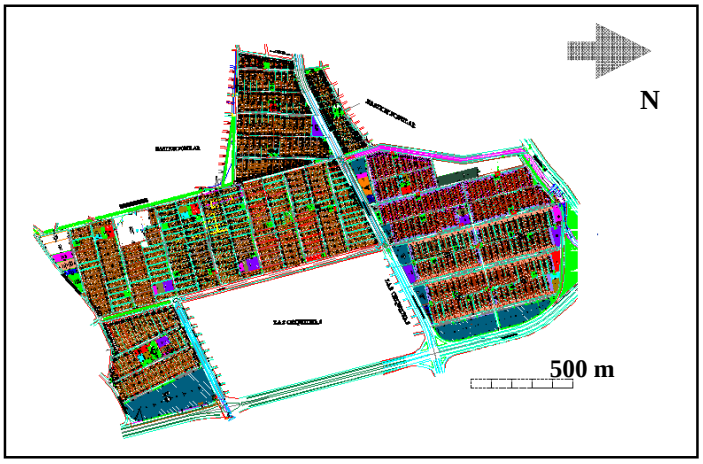


**Fig. no. 8. "Mucho Lote" Project**
**Source:** Municipality of Guayaquil, Direccion de Terrenos, 2006

Some similar developments have been planned, like "Mucho Lote 2" in areas nearby the new high speed way "Autopista Terminal Terrestre Pascuales",[16] to the North-East of the city, and "Mucho Lote 3". The project "Mucho Lote 2" will be called "Mi lote", and it will consist only on the selling of plots by the Municipality, this will be conformed of 3.500 housing plots. "Mucho Lote 3", would be intended for a lower income group, in the areas nearby the "Perimetral" high way.

Additionally, at the governmental level, the Minister of Housing MIDUVI, is also promoting a housing programme that is called "Socio Vivienda", which is going to be implemented in an area of 38,7 has. It will be located in an extension of land located between the cooperatives Nueva Prosperina (to the North), Lomas de la Florida (to the South), Guerreros del Fortin (to the West) and a water channel (to the East). The project will be conformed of 2.700 plots for residential uses, and there will be also green and recreational areas, communal areas and commerce.

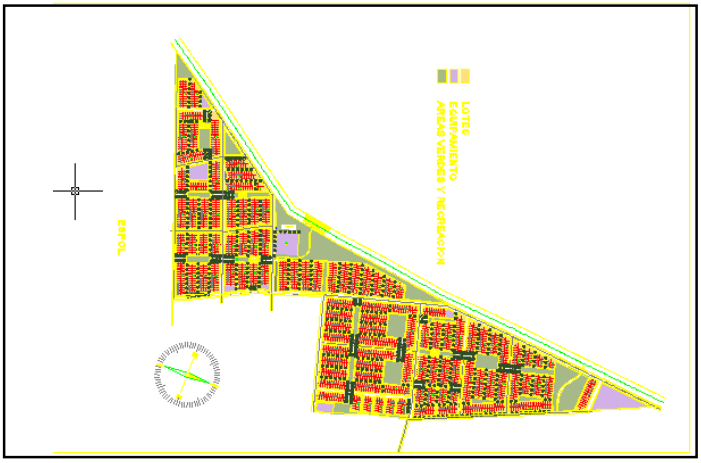

**Fig. no. 9. "Socio Vivienda" Project**
**Source:** MIDUVI, Minister of Housing and Urban Development of Ecuador, Arq. Francisco Estarellas; Design: Arq. Victor Carrera, 2007

[16] Not an specific location have been yet officially provided for these projects by the Municipality

Then it is possible to calculate the **average area that will be needed** for housing development for the low income group of the population, taking as a base the density used for the project "Mucho Lote", which correspond to 0,0135 plots/ha ( 189 has/14000 plots), thus the area needed for this kind of housing developments would be 756 has., which correspond approximately to 4 projects with similar characteristics of "Mucho Lote".

The future locations for these projects are mainly along the roads axis crossing the city in the North area as it is shows in fig 10. Future provision of roads infrastructure is considered but provision of basic services have to be considered as well, besides improvement and allocation of projects for recreational activities and green areas for these zones.

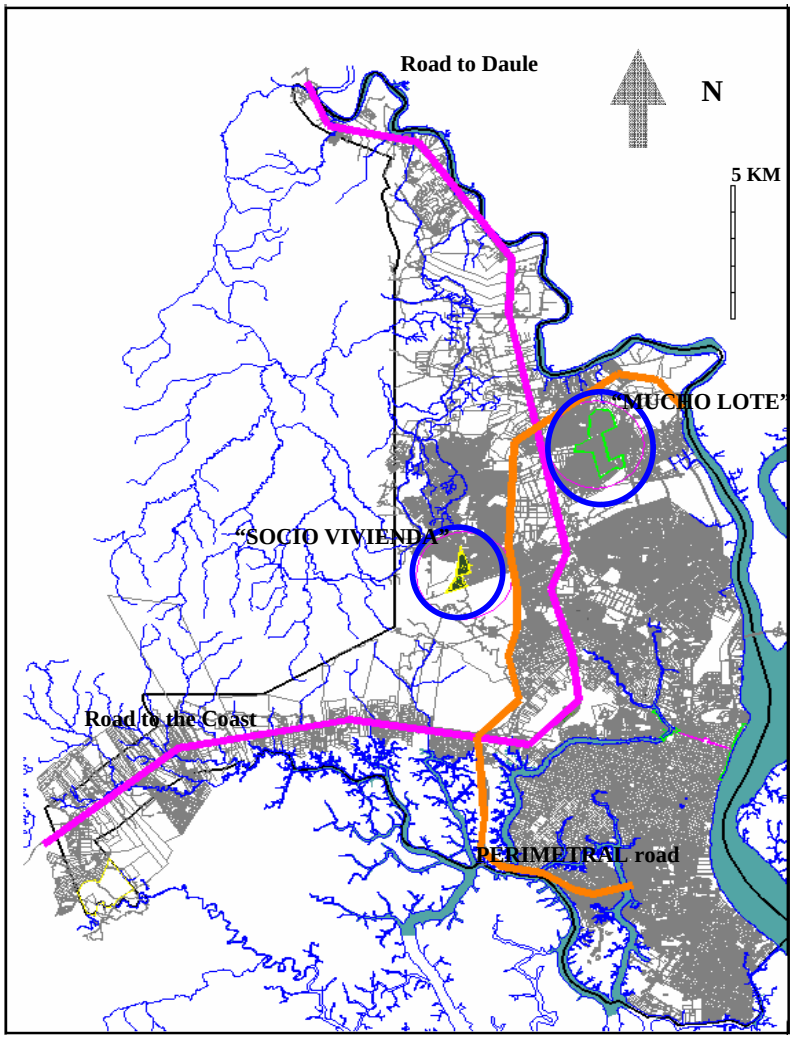


**Fig. 10. Location of projects "Mucho lote" and "Socio vivienda"**
**Source:** Municipality of Guayaquil; MIDUVI, Minister of Housing and Urban Development of Ecuador.

## 3. The Conceptual and Methodological basis for the integrated cost-quality approach

The present study uses an integrated approach since different stakeholders involved are addressed and the complex interactions between different housing variables in the whole process of urban housing development are included, like housing and urban design parameters,

location, green areas, basic services and infrastructure; quality evaluations; profitability margins for private contractors and affordability levels for the population.

A methodological tool had been used, comprising a combination of simulation models, quality evaluation techniques and an evaluation of the potentialities and applicability's of the method. Different aspects are considered like: design parameters for housing units, plots and urban environment; quality evaluation by weighted scores and value points in order to obtain a market sales price. A demand curve is also considered based in a reduction price per number of units, and finally profitability margins and affordability prices plus financial possibilities for the final housing users.
The main parts of this integrated approach could be summarized as:
- Housing costs
- Quality evaluations based on a hierarchical classification of housing characteristics
- Phasing possibilities-housing types
- Housing annuities-income groups of population

Given the diversity and complexity of the many factors involved a combination of quality evaluations methods have been used. The aim of this paper it is to present a methodological tool to assists several stakeholders (corresponding to different profiles and expected outcomes) in the housing market to make better-founded decisions. These users profiles and corresponding aims can be characterized as follows:

- The designers to evaluate the influence of their options on the final quality and cost of the housing development
- The Government to define urban and loan policies as a function of quality levels and people's preferences in order to promote the construction and acquisition of higher quality housing.
- To the financing entities to promote financial plans accessible to low income groups
- The promoters to adjust projects to consumer profiles
- Local municipal agencies to promote adequate urban policies based in qualities evaluations and preferred urban developments adequately inserted in the urban grid of the city.
- The consumers to select a house in accordance with their financial capabilities and preferences.

**3.1 Main methodological parts of the quality evaluation:**

The methodological tool presented in this paper integrates three main evaluation techniques: an identification of main housing characteristics, a weighting score percentage for each of those housing characteristics, and an evaluation in quality points per characteristics in order to obtain a market sales price.

For the implementation of this method special attention is put on: ( i ) first the identification of main housing characteristics (design quality, construction costs, construction quality, location, accessibility, environmental quality, land value, etc) ( ii ) the hierarchical classification of these housing attributes for posterior analysis and surveys, so that the evaluation could also be performed at any level of the hierarchy; (iii) the selection of adequate multi-criteria evaluation methods; ( iv) the inclusion of qualitative an quantitative information in order to assess the score evaluation of the different attributes, including the comparison with established standards ( e.g. noise control, comfort dimensions, planning and environmental standards); (vii) the analysis of alternatives and evaluation of main results.

Following the identification of main characteristics, it is also substantial the recognition of a "reference" package in order to established comparisons and also to allow the consequent breakdown of the hierarchical classification of attributes.

### 3.1.1 Identification of main housing characteristics for quality evaluations

Preliminary housing characteristics are determined, in order to keep a provisional clear idea of the influence of these main characteristics over the final profitability and affordability results of the evaluations. The main characteristics chosen for this research are:

- Housing unit ( m2)
- Land (m2)
- Urban environment :
    - Communal services (%) of area
    - Green areas (%) of area
    - Circulation (%) of area
    - Location (scp) score points

These characteristics had been previously chosen based in an extensive literature review; primary sources as national journals, magazines; secondary sources as informal interviews, policy statements from the Municipality planning. The importance of identifying these housing characteristics is strongly related with the context, eliciting from the process people's preferences for a specific "package" of housing characteristics and attributes. In fact, defining a good *value* for *money* is a question that have neither been posed explicitly nor answered in a satisfactory way, and relates to find the optimal combination of housing characteristics, an "optimum" package that could work as a reference for the methodological process of housing quality evaluations for low-income groups.

### 3.1.2 The weighted importance of that "optimum" package

Once those main housing characteristics have been identified it is necessary to validate what is the maximum amount of money that people will be willing and able to pay for that "perfect" package. This is initially determined based in primary and secondary sources of the context and this will be subsequently validated for further field research.
This maximum price that each corresponding income group will be willing to pay for a certain type of house will serve as a reference for a further hierarchical breakdown of housing attributes, which consists on the weighting of the relative importance of each "characteristics" of that total "optimum" package.
For this is specially applicable the multi-criteria decision analysis approach, in which criteria can be used retrospectively or prospectively and that could serve as in the case of this research to appraise things that are as yet only proposed.

### 3.1.3 Hierarchy of the attributes that characterize the price of a house.

The main identified characteristics of a house for quality evaluations could be further subdivided in multiple attribute with different relative importance over the price of a house, ranging from the intrinsic aspects of the construction process, to environmental and location aspects. Many sources[17] were consulted in order to analyzed these attributes based in multi-criteria decision analysis and hierarchic methods. Different level of this hierarchy could be identified ranging from the main housing characteristics that are used for this analysis to further subdivisions of elements and attributes.

[17] Initially based in literature review and also from primary and secondary sources in previous field work. Primary sources as national journals, magazines, and secondary sources as informal interviews to public policy makers, private developers, users; policy statements from the Municipality, the Master Plan for the city.

| Level 1 | Level 2 | Level 3 | Level 4 |
|---|---|---|---|
| **1** TECHNICAL CHOICES | Elements-finishes | external walls | Primary elements of wall |
| | | | Secundary elements |
| | | | Final finishing of outside surface |
| | | | Final finishing of inside surface |
| | | internal walls | Primary elements of wall |
| | | | Secundary elements |
| | | | Final finishing of inside surface |
| | | ceiling | |
| | Installations | kitchen fittings | |
| | | Toilet fittings | |
| | | *low flush* | |
| | | *shower* | |
| | | *handwash basin* | |
| | | Laundry fittings | |
| **2** LAYOUTS | Houses and plots | Size | w |
| | | | d |
| | | Shape | ratio |
| | | Expansion possibilities | front |
| | | | side |
| | | | back |
| | | | number of floors |
| **3** URBAN-ENVIRON. | Distance from houses to bus stops | | |
| | Distanc e to the city center | | |
| | Comunal services | | |
| | Green areas | | |
| | Circulation | | |
| | Location criterias | Land market | Land market value |
| | | | Land property |
| | | | Land use - Master plan |
| | | Soil conditions | |
| | | Accesibility- existing roads | Roads typology |
| | | | Roads condition |
| | | Infrastructure provision | Water supply |
| | | | Electricity |
| | | | Sweage system |
| | | | Telephone |
| | | | Garbache recolection |
| | | PublicTransportation | |
| | | Landscape qualities | Land slopes |
| | | | Natural resources |
| | | | Prevailing winds |
| | | | Micro-climate |
| | | Contamination sources: | quarries |
| | | | industries |
| | | | sweage system |

**Fig. 11. An example of a hierarchic breakdown of characterized housing attributes.**

One of the main objectives of this study it was not just to make a list of the largest possible number of attributes, but just a list of the ones that could have a bigger influence in the value of a house as a result of people's appreciation of those attributes. This provisional set of characterized attributes will be subsequently validated through surveys target to the users of the houses on the one hand and to the decision makers and planners and developers by the other hand. A provisional set of attributes is determined, which can later be modified and completed as a result of changes in perceptions and preferences

An example of a hierarchic breakdown of characterized housing attributes is given in fig.4, in which level 1 correspond to technical choices, layouts and urban environmental characteristics. For technical choices, point 1, just few main attributes that could have a significant influence over the selling price as a result of people expected preferences have been considered. This selection had been made base on field work, as a result of this in level 3, just attributes corresponding to walls and ceilings had been considered. A further sub-classification of these elements in level 4 is made, as for the walls options for the different wall layers. In what correspond to installations it have been studied just the influence of features related to sanitary installations, as for the bathrooms and kitchen.

For point 2, layouts, different possibilities for the layouts of houses and plots have been considered, related to size, shape and expansion possibilities. For point 3, urban environmental characteristics, different attributes have been considered, in what is related with distances from houses to bus stops, distances to city center, communal services, green areas, circulation and

attributes for locations that are further breakdown in a series of attributes for the location, like land market; soil conditions; accessibility – existing road infrastructure; infrastructure provision, as water supply, sewage system, electricity, garbache recollection; facilities of public transportation, landscape – environmental qualities, contamination sources.

### 3.1.4 Quality evaluation for a market sales price and further analysis: profitability margins and housing annuities.

The quality evaluation will allow determining provisional sales market values for the different housing typologies, based on their characteristics and appreciations by the population. Different possibilities for a better trade-off of cost and qualities are analyzed. This quality evaluation will be based in a system of score points in relation of the amount of the appreciated housing characteristic. The number of houses to be provided is considered in a demand curve in order to obtain a better optimized price for this, getting a reduction price in accordance with housing number.

The profitability margin issue for private contractors will be further increase or decrease by phasing project possibilities, in a cash flow of costs and incomes of an urban project, considering different housing typologies and assuring also profitability margins for the contractors. The affordability for the population is considered through housing annuities for different income groups and their financial possibilities and willingness to pay for the houses.

## 4. Cost modeling simulations tool

The above identification of characteristics and subsequent steps of the methodology will be supported by a simulation tool. The methodology developed for this first part relies in the Element Method for Cost Control[18]. This method is based in an extended database of prices for the different elements and sub-elements required for the estimation of the cost of a house For the classification of materials, elements and sub-elements a system for codification had been chosen[19]
Besides the first part corresponding to the Element Method simulations are also made for subsequent models as the location model and the quality model. For each of the housing characteristics defined in the first part of the methodology individual models could be developed and subsequently linked to a main model in order to summarize and clearly identified the main housing characteristics. The main models developed with a link to this page are:

- The cost model
- The location model
- The quality model

The **cost model** is developed based in the Elementh Method of Cost Control. Each element is constituted of "work sections" selected from the database. . A ratio at the element level is defined as the amount of "work sections" per unit of element. At the building level is defined as the quantity of an element per square meter of the total floor area, this is for instance, the amount of walls in relation to the m2 of house.

The elements are defined in such a way that these are as independent as possible, different possible combinations of materials for elements and sub-elements are therefore possible. For each element the cost is defined and finally elements are combined at the building level by multiplying the cost per unit element with the respective ratio, this allows to obtain the cost for a specific dwelling type. The Element Method provides a tool to control the effect of changes upon decisions based in type of materials, construction technologies and layouts upon the final cost of a dwelling type.

[18] De Troyer, Frank, Element Method for Cost control,
[19] De Troyer, F., Neuchermans, H., Havenne, D., Simon,F., BB/SfB-tabellen 1990, Brussel

The **location model** allow us to see all the characteristics related with the location of an urbanization into the urban fabric of the city , taking into account the provision of public spaces or infrastructure nearby. The hypothesis is that the provided quantity of housing characteristics will affect the sales value of the house. These characteristics are based on local norms[20] for provision of spaces for urban development and also based in the sales housing market and municipal plans for development of the city. The conditions of the soil, landscape, possibilities of transportation to work places, to the center of the city, accessibility of each possible site upon sales values are to be modeled.

| | Locations | | | Scores | | |
|---|---|---|---|---|---|---|
| Targeted areas | x | y | z | **x** | **y** | **z** |
| Affected groups | | | | | | |
| Decision makers | | | | | | |
| Interests groups-users | | | | | | |
| 1 Land market value | 80 | 120 | 60 | 2 | 1 | 3 |
| Land property | | | | | | |
| Land use - Master plan | | | | | | |
| 2 Soil conditions | 1,4 | 1,9 | 0,9 | 3 | 4 | 2 |
| 3 Accesibility- existing roads | | | | | | |
| Roads typology | 40 | 18 | 40 | 4 | 3 | 4 |
| Roads condition | 85 | 70 | 85 | 4 | 3 | 4 |
| 4 Infrastructure provision | | | | | | |
| Water supply | 95 | 90 | 100 | 3 | 2 | 4 |
| Electricity | 95 | 95 | 100 | 3 | 3 | 4 |
| Sweage system | 85 | 70 | 75 | 3 | 2 | 2 |
| Telephone | | | | 3 | 3 | 3 |
| Garbache recolection | | | | 3 | 2 | 3 |
| 5 PublicTransportation | 26 | 42 | 30 | 2 | 1 | 2 |
| 6 Land qualities | 5-10 | 0-5 | 5-10 | 3 | 4 | 3 |
| Land slopes-topography | | | | | | |
| Natural resources | | | | | | |
| Prevailing winds | | | | | | |
| Micro-climate | | | | | | |
| 7 Contamination sources: | | | | 3 | 2 | 3 |
| quarries | | | | | | |
| industries | | | | | | |
| sweage system | | | | | | |
| 9 Main projects considered in the | | | | 3 | 2 | 4 |
| urban master plan for the city | | | | | | |
| *New terminal of buses for the city* | | | | | | |
| *New airport-Daular* | | | | | | |
| *Tunnel-Cerro San Eduardo* | | | | | | |
| *Urban Parlk-Malecon Norte-305 has.* | | | | | | |
| TOTAL SCORE | | | | 39 | 32 | 41 |
| Weighted factor | 0,25 | | | | | |
| total scorepoints | | | | 10 | 8 | 10 |

**Fig. 12a. Location model showing evaluation table for location conditions.**

[20] Municipality of Guayaquil, *2000,Ordenanza del Plan Regulador de Desarrollo Urbano de Guayaquil*

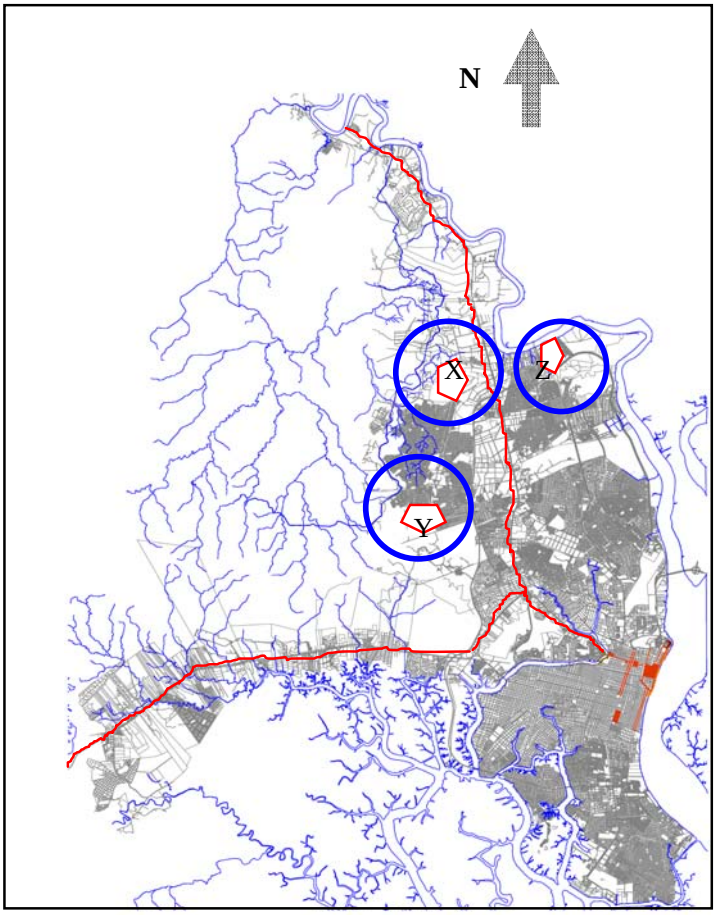


**Fig. 12b Location model showing main possible location possibilities for urban developments in the plan of the city.**

The scores given for each of the characteristics for the location model are based in the norms established for the context, for construction, housing and urban design, in market values and the morphologic characteristics of the urban environment of the city. For instance for soil conditions , this characteristic is directly related with the cost of foundations and that depends of the area of location of the project. There are some low areas of the city, specially at the South were the level of the underground water is just one meter below the surface and this increase the cost for foundations due to the necessity of improvement of this soil; areas at the North of the city have more stable conditions of the soil and the cost of the foundations can be significantly reduced and for hence the cost of the house.

The **quality model** is made based in the main identified housing characteristics; these are layouts, technical choices and urban environment. A hierarchical classification is made based in a further subdivision of these different housing attributes, using for this the Analytical Hierarchical Method. These attributes are selected in order to determined the total cost of the house considering construction costs, the land, and the urban environment in which this house will be inserted as communal services; green areas; circulation; distance from a medium point of the urbanization to the center of the city; and location of the urban development.

This quality model is also included in the cost model in the main identified characteristics that have been tested to have a significant influence over the price, based on the previous survey of people's preferences. The inclusion of some quality evaluated elements will allow the user to

see the consequences of choices on the level of the "element "and sub-element upon profitability.

### 4.1 An integrated model

This model comprise the different parts of the Element Method involved in a housing cost evaluation, a quality evaluation summary (QAES) for each housing type, phasing possibilities for the urban development with housing types and housing annuities for different income groups. The links of the integrated model will allow to the user to see the consequences of changes in input parameters of design options, housing characteristics upon a sales value of housing and the effect upon profitability margins for developers and users affordability.

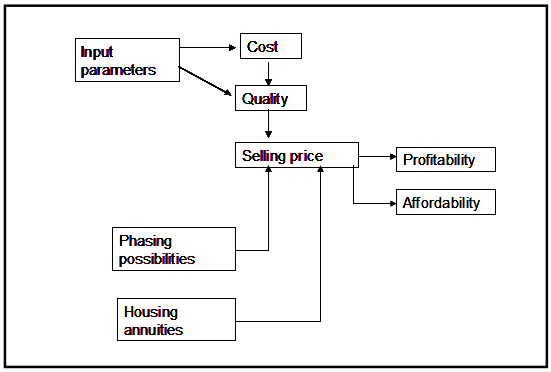


**Fig.13. Scheme of the methodology of the integrated approach for cost/quality evaluation upon profitability for the developers and affordability for the users**

#### 4.1.1 The quality evaluation summary (QAES)

A quality evaluation summary is carried our for each of the main provisional set of housing characteristics, assigning certain points per quantities of housing characteristics and then each of this will be multiplied for certain euros/quantity in order to arrive to a certain market sales price for an specific housing type.

In order to establish the points per quantities for each characteristic, two ways could be considered: as a score function or by direct rating. As a score function it is determined the best and worst option for each characteristic, and once these end points are established, scores are considered as a value function or by direct rating. As a value function it is possible to obtain in this way for each technical characteristics the corresponding score point. Subsequent links to further models developments for the other characteristic of urban environment and housing could also be made.

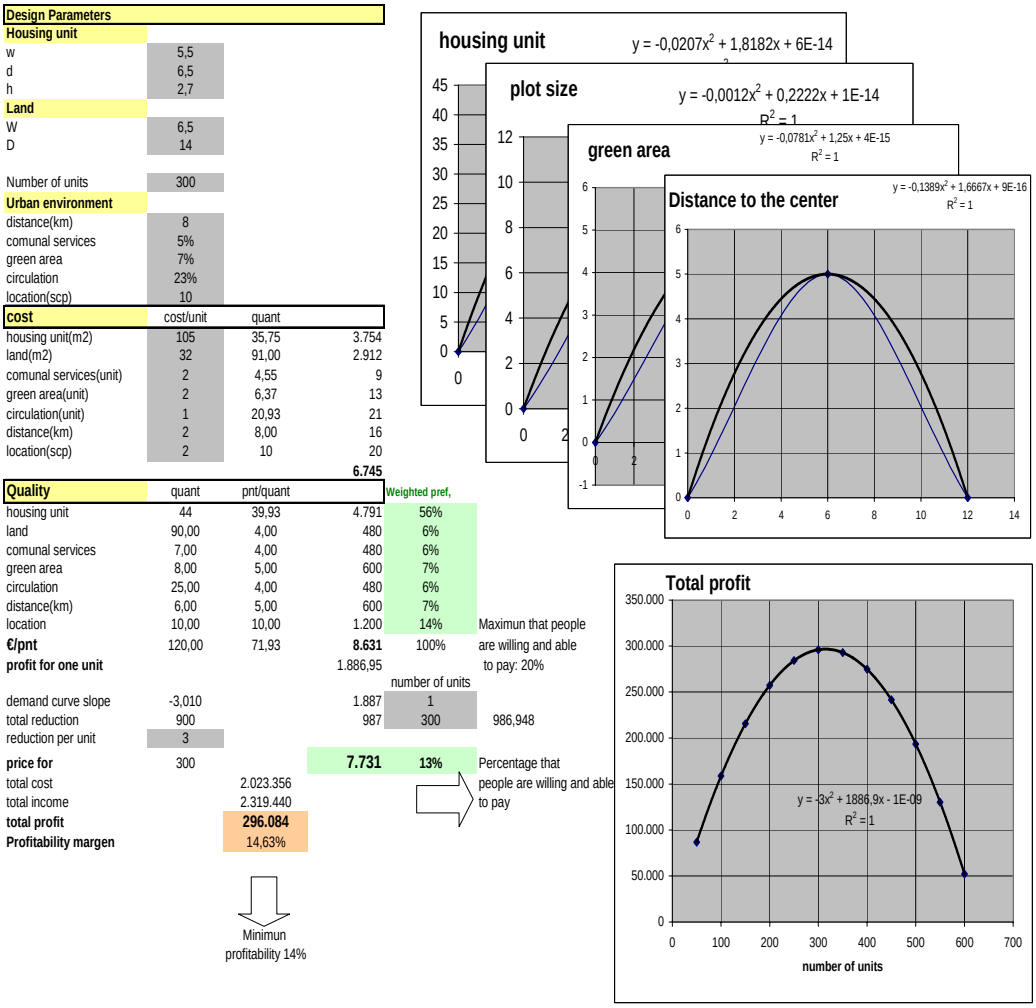


**Fig.14. Spreadsheet showing the summary of main housing characteristics**

The results showed on this page summarize the principles of the model and they allowed us to analyze the impact of some parameters over the profitability margin and the affordability for the population. Any chance that is made over the size of the house and plot will affect the profitability and affordability issues. For instance in what is related for the **Distance** characteristic, which is the distance from a medium point of the project to the city center, in accordance with the above conditions for each km that this middle point is getting away from the center, the profitability is diminish in 1% and from 9 and 10 km and further the profitability it will be reduce in 2-3% progressively. For the **width of a house** from 5 m. for every 0,5 m. that the width is increased there will be a reduction of 4% in the profitability margin and from 6 mts width it will increase progressively in 6%. For **green areas** it is showed also that every point percentage that is diminished in percentage increased one point of percentage for the user affordability and reduced one point percentage the profitability for the private contractor. For **communal services** instead, reducing one point the percentage of this area will diminished one point percentage the profitability for the contractor but increased just half point the user affordability.

It is also showed in the above figure the curve corresponding to the **total profit**, which depends in more than one parameter, as the design parameters of the house, plot and changes in quantities, cost or score based in the value functions will be clearly graphically illustrated. This

optimal combination will be provided to private contractors assuring them a minimum profitability margin, in a trade-off between increasing cost and keeping qualities, in order to provide a better and affordable quality of life for the future inhabitants of those urban developments.

#### 4.1.2 Phasing possibilities - Using different housing types

A spreadsheet showing possible phasing possibilities of the different investments needed for the implementation of an specific urban development project is also included in the model, considering for this an overall general positive profit and return on investment. In a first part the different parameters of areas for provision of communal services, green areas to the project are inserted in percentages, as in the case of housing, determining the number of houses that will be needed for the project.

Based on the number of houses that could be developed for each specific area of the project a demand curve for the sales prices is included in order to obtain a reduction for the sales price. Different housing types are included and linked based in the first part of the model of the Element Method of Cost control. Phasing possibilities for investments are tested upon the profitability margin for the developer over the total urban project. The allocation of public spaces is analyzed upon the profitability and posterior recovery of investments.

#### 4.1.3 Housing annuities - For different income groups

Based in the housing types considered in the first part of the model, different possibilities of housing annuities for different income groups are considered based for this in their perception and willingness to pay for the different housing types and their characteristics. This provisional set of preferences of people's population is obtained based from primary and secondary sources and needs to be further validated for subsequent surveys. A maximum profit combination is obtained based in this modeling simulation using solver analytical function.

## 5. Conclusions and further research

The process of modelling costs and quality of housing units and public spaces involves the analytical and methodological determination of all the factors influencing the market value of a house. This paper presented some of those factors: construction costs are considered for different housing types, besides of a quality analysis based in people's preferences leading to a certain market housing value, phasing possibilities and housing annuities. The translation of this into a simulation tool and first implementation into dwelling types with quality evaluations has been elaborated. Further simulations with more housing types, urban developments and income groups will allow checking financial possibilities for users and profitability margins for private developers.

The methodology and simulation tool presented in this paper aims to provide more insights into the desired balance of cost and quality for an urban development, considering people's preference as the added value that could ensure private contractors an adequate profit. This will also help public developers with the identification of priority public spaces and provision of basic infrastructure needed by the population. Besides adding value to urban developments and contributing to a better and more coherent urban growing of the city. Further research will appraise and validate some points of this process and to present the whole picture of the "iceberg" for this specific context, of which just it is presented an initial but not for that less important first part.

## References


*(1)* Bowen, P.A., Edwards,P.,J., 1985, *Cost Modelling and price forecasting: practice and theory in perspective*, Construction Management and Economics,3. 199-215

*(2)* Choguill, Cha., L., 2008, *Developing sustainable neighbourhoods*, Habitat International, 32, pp. 41-48

*(3)* De Troyer, F., 2007, Bouweconomie en Systeembouw, ACCO, Leuven

*(4)* BB/SfB, 1991, Elementenmethode, Rijswijk, Stichting Bouwkwaliteit

*(5)* Dodgson, J., Spackman, M., Pearman, A., Phillips, L., Multicriteria analysis manual, NERA, National Economic Research Associates.

*(6)* Greene, M., Ortuzar, J., de D., 2002, *Willingness to pay for social housing attributes: a case study from Chile*, International Planning Studies, Vol. 7, No. 1, pp.55-87

*(7)* Emily Joiner, 2007, *Murky Waters, A Critical and Purposepul Look at the Water and Sanitation Process in the City of Guayaquil*

*(8)* Instituto Nacional de Metereologia e Hidrologia,2007, Serie de datos hidrológicos caudales médios mensuales (m3/s), (Guayas)

*(9)* Interagua, *Planes de expansion de Agua Potable*, 2001-2006

(10) K.Allacker, F. De Troyer, C.Spirinckx, L.De Nocker, A. Vercalsteren, B. Tomaseting & K.Putzeys, 2008, *Striving for a more sustainable Belgian dwelling sto*ck, The sustainable city V, pp 335-344

(11) Fernandez-Maldonado A.M, Fernandez-Davila A. 2007, Malecon 2000 as a strategic project for the regeneration of Guayaquil, in 43th IsoCaRP Congress

(12) Municipality of Guayaquil, *Indicadores urbanos Ciudad de Guayaquil*, 1993-2000

(13) Municipality of Guayaquil,*2000,Ordenanza del Plan Regulador de Desarrollo Urbano de Guayaquil*

(14) Municipality of Guayaquil,2007,*Ordenanza que reforma a la Ordenanza del Plan de Desarrollo Urbano de Guayaquil*

(15) Municipaly of Guayaquil, *Informe de Avance de Objetivos de Desarrollo del Milenio en Guayaquil*, United Nations, Centro de Investigaciones Sociales del Milenio, Cismil

(16) Natividade-Jesus, E., Coutinho-Rodrigues, J., Henggeler C., A.,2007, *A multicriteria decision support system for housing evaluation*, Decision Support Systems, 43, pp 779-790

*(17)* Tiepolo Maurizio, 2007,*The Barrio Marginado Regularization in Guayaquil-Ecuador*, Politecnico di Torino, Working paper no. 27

*(18)* Tuts R., 1996, Cost Modelling for appropriate building and planning standards in Kenya, Habitat International, vol. 20, No. 4., pp 607-623

*(19)* Wayne R., Archer, Dean H. Gatzlaff, David C. Ling, 1996, *Measuring the importance of location in House price appreciation*, Journal of Urban Economics, vol. 40, pp. 334-353