Exploring Space Ergonomics As Design Approach for in-Situ Rehabilitation of Kebele Houses (in Inner Cities of Addis Ababa)

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Abstract:- **Spatial efficiency lacked attention compared to the gap between housing supply and demand in Ethiopia. Inner cities of Addis Ababa are highly densifying of people being drown into which resulted in excessive infrastructural housing load causing crumbling housing scenarios. Opportunities and economical demands lead housing units transformed into commodity generating income thereby creating space problems and deterioration in living conditions.**

The research method used case-study approach. Live case of selected inner city area were carried out. 50 households were selected and observations of the current condition of the neighborhood were made to examine spatial, economic, and social characteristics of given area. The research combined qualitative and quantitative methods to generate valid data for design inputs.

The major findings were that the rooms in the dwellings served several functions along with their functions changed during the course of the day. The common functions performed inside the dwelling were sleeping, dining, and storage where space permitted. Other domestic functions (cooking, washing, bathing, latrine and social interaction) took place outside the dwelling unit. Spaces were relatively smaller to the number of occupant's causing it to be very crowded. In addition to poor living conditions a conflict between the shared spaces can been seen dominantly between HBE's activities and domestic activities. Also observed were boundary conflict between neighbors, dwellings materials found to be non-permanent, poor quality structures made with perishable construction materials (wood and mud) & presence of informal add-ons. The study recommends space ergonomically designed solutions for various user issues in accordance with the measured potentials of growth and sustainability.

Keywords: Inner cities, HBE's, space ergonomics.

I. INTRODUCTION

At an urbanization level of around 40 percent, African cities are relatively poorer than other developing regions when they were at similar levels of urbanization.[1] Because per capita GDP is low, public and private investments in housing, infrastructure, and other capital are lacking.

The housing problems in urban centers take the form of slum dwelling, homelessness, overcrowding, squatter settlements, and substandard housing units.[2]

Housing problems generally in Africa face a major housing crisis due to rapid urbanization and a growing slum population. "As a result, 90 percent of Africans live in informal housing, where living conditions are often substandard, unsafe and without basic services like water, electricity, and sanitation. New, targeted approaches to affordable housing are necessary if countries want to take advantage of the demographic shift to make cities inclusive, spur economic growth and expand job opportunities, according to a new report by the World Bank Group.[3]

II. SPACE ERGONOMICS CONCEPTUAL FRAME WORK

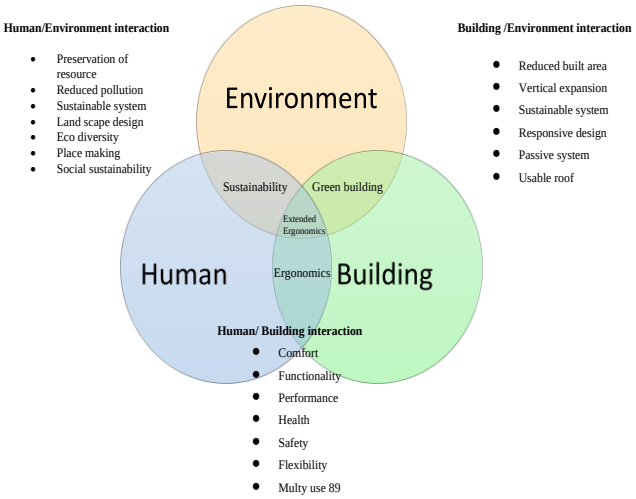


Figure II-1 A framework for scopes of ergonomics driven architectural design

Ergonomics "the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance". [5]

All categories of ergonomics are influential on architectural design: application of physical ergonomics can help produce more human centered spaces; organizational ergonomics helps optimize the performance of buildings.[6]

III. THE CONCEPT OF URBAN RENEWAL

Urban renewal is described as an intervention to transform urban areas by improving the built environment and infrastructure, thereby improving the quality of life and providing social services. It has also improved economic conditions and employment opportunities, social and economic characteristics, and environmental and ecological conditions.[7]

Urban renewal approach for rehabilitation program

Rehabilitation: doesn't involve the displacement of the occupant, it is less costly than a total replacement. Rehabilitation; involves making improvements to existing buildings for the same or more intensive use. In addition, he commented, "Rehabilitation can simply reverse neglect and deterioration so that the building can continue to provide acceptable levels of service.[7]

IV. HOUSING NEED AND HOUSING DEMAND

Housing need and housing demand can often be confused yet they have different meanings. Every household has a housing need irrespective of income or type of housing.[8]

Housing needs - is described as "the quantity of housing required to the accommodation of the agreed minimum standard and above for a population given its size and household composition without taking into account the household `s ability to pay for the housing assigned to it".

Housing demand - as the relationship between "the price of housing and the quantity and quality of housing for which people are able and willing to pay".

Housing demand is mainly affected by the price of housing and the factors surrounding it such as supply and income, addressing these factors has led to not only solving current needs and demands but also the importance of planning for the future. In conclusion for current housing needs and demands to be met larger amounts of housing must be provided at an affordable price and of good quality, by setting and reaching targets will hopefully meet the needs and demands of the present and the future:

V. AFFORDABILITY

Affordability has been studied and its definition and perception have been refined and is generally agreed that affordable housing does not force households to spend beyond their; capability and willingness to spend. Capability implies income and willingness alludes to choose so affordability implies that people can and want to spend on housing.[9]

A. Factors affecting affordability

The ability to pay has two sides, the external and the internal side[10]

- The external factors- Factors that affect the cost of housing, which include the sums of land acquisition, infrastructure, both on and of the site, planning, designing, interest rates, and subsides.[11]
- Internal factors that affect affordability have to do mainly with the socio-economic circumstances of the target group [12] and their social character .

  The socio-economic circumstances can be affected by employment opportunities, Kinds of occupation, Income, and expenditure patterns. While social character is affected by the house holds size, family structure, needs, customs, aspirations, and priorities. In terms of significance, the social character of the community will determine its willingness to pay, whereas the economic character determines ability. But two relationships are not neatly defined it is a complicated relationship where each affects the other."[10]

B. Affordability index in Africa

Only few countries in Africa have developed an affordability model for housing among the countries Kenya and Nigeria are some of them.

Nigeria: The findings reveal that there are three major factors affecting housing affordability including household attributes 57%, housing attributes 10% and macroeconomic variables 33%. Each major factor consists of several individual elements with different scores and weights. Household attributes consisting of income scoring 62%, household size 62%, age 62%, occupation 54%, stage in life cycle 46% and migration status scoring 15%. Housing attributes consisting of location 8%, house type 23%, quality of house 8%, cost of land 8% and size of house 8%. Macroeconomic variables consisting of mortgage rates scored 62%, subsidies 54%, inflation rate 38%. This suggest that households attribute (57%) is the most important major factor while income 62%, age 62%, household size 62% and mortgage rates 62% are important individual elements.[13]

Affordability can therefore be conceptualized to be a function of housing demand and supply, which are in-turn influenced by factors related to the macro-economic environment, property characteristics, mortgage loan characteristics, demographic and household social economic factors and a host of other factors that directly influence housing price, interest rates and household income.[14]

Table V-1 Factors That Affect Affordability of the Housing Sector in Kenya

Social-economic factors	
• Age • Gender • Marital status • Number of family members with income • Level of education • Household size	• Number of dependents (outside the nuclear family) • Job-status • Loss of regular employment income
Property factors	
• Location of property	• Size of house

• Size of land • Value of land	• House design • Construction cost • Transaction cost • Developers profit
Macro-economic factors	
• Inflation • Gross domestic product (GDP) per capita • Exchange rate	• Unemployment rate • Performance of alternative markets • Political climate

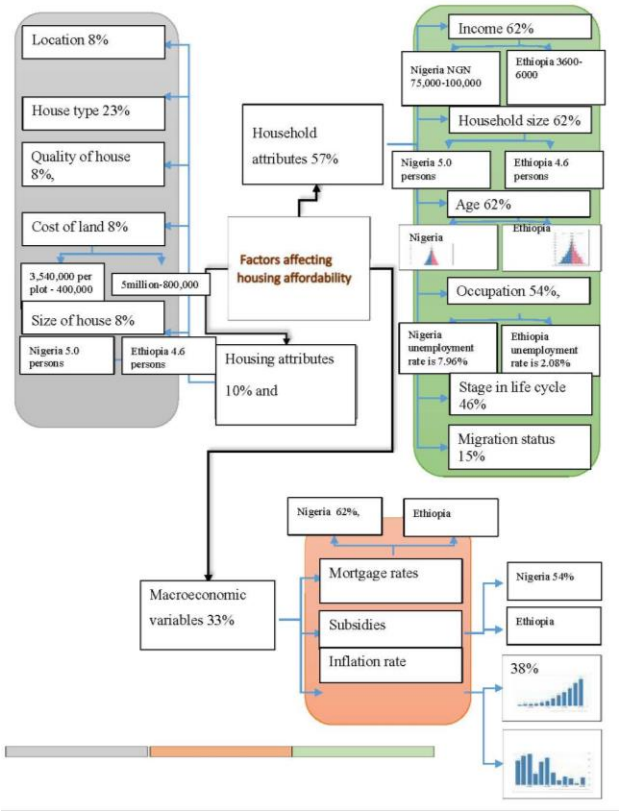


Figure V-1 Affordability model for Nigeria and Ethiopia

C. Evaluative model in Addis Ababa

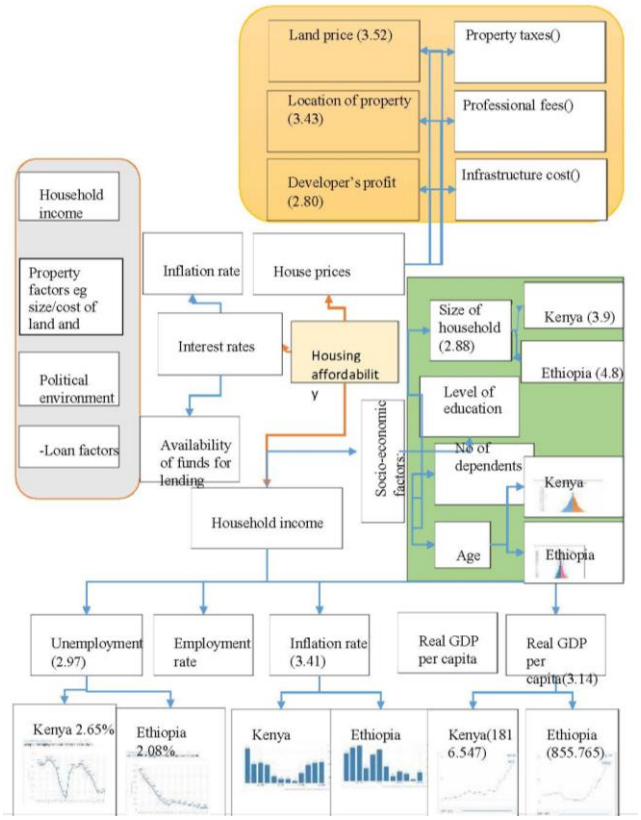


Figure V-2 Affordability model for Kenya and Ethiopia

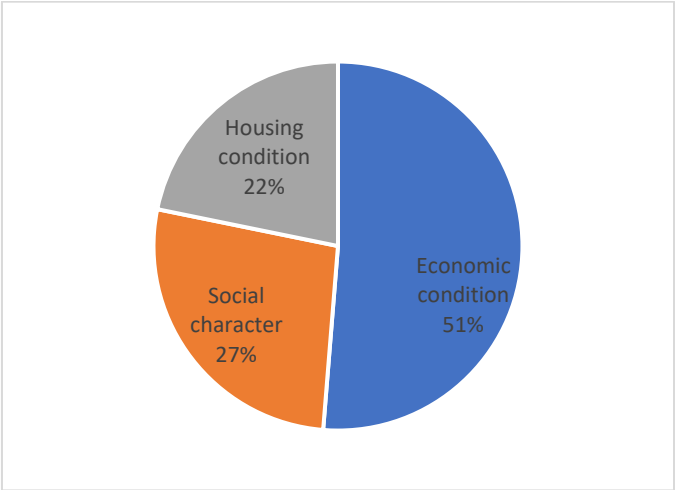


Figure V-3 Factors affecting housing affordability in Addis Ababa, Ethiopia

The affordability of housing is determined by factors among those factors it has been seen among these factors a person's ability to afford housing is majorly affected by the economic condition, social character Age, and housing condition respectively.

Affordability plays a key role in any types of space ergonomics because spatial need of the people should be supported by the affordability factors.

VI. EVALUATION OF HOUSING CONDITION IN THE INNER CITY OF ADDIS ABABA

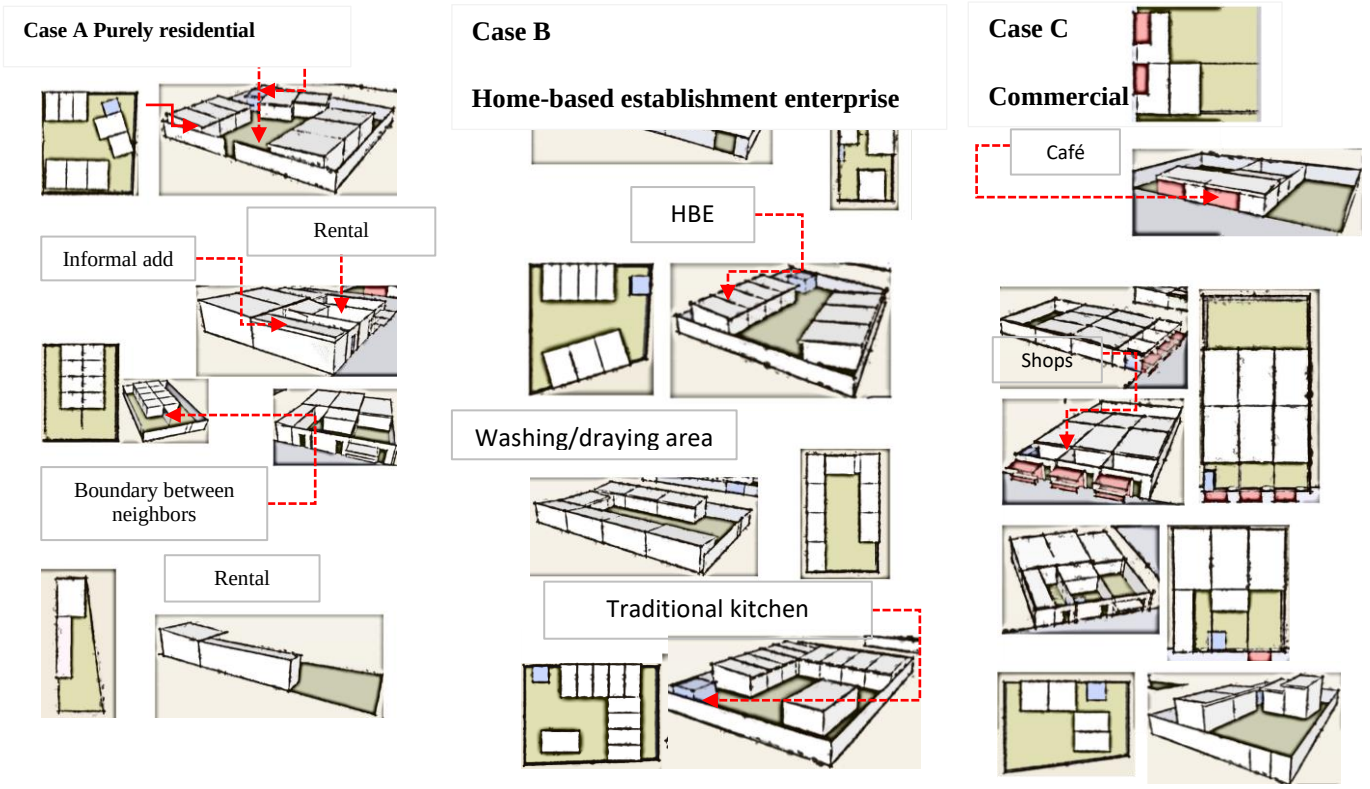


Figure VI-1 Plot character & neighborhood existing conditions

A. *Space Usage*

The space is very small in relative to the residents causing the area to be very crowded. Rooms serve several functions, changes during the course of the day. The common functions performed inside the dwelling are sleeping, dining, and storage. Where space permits, the rest of the domestic functions (cooking, washing and bathing, latrine and social interaction) take place outside the one room dwelling.

B. *Shared spaces conflicts*

There are Conflict of double functioning of home, proper allocation of time to HBE and domestic activities is required. The risks to the home due to HBES (health, security, crowding), noise and bad smell.

• Boundaries: The need for extra space courses conflict between neighbors.

C. *Poor quality of life*

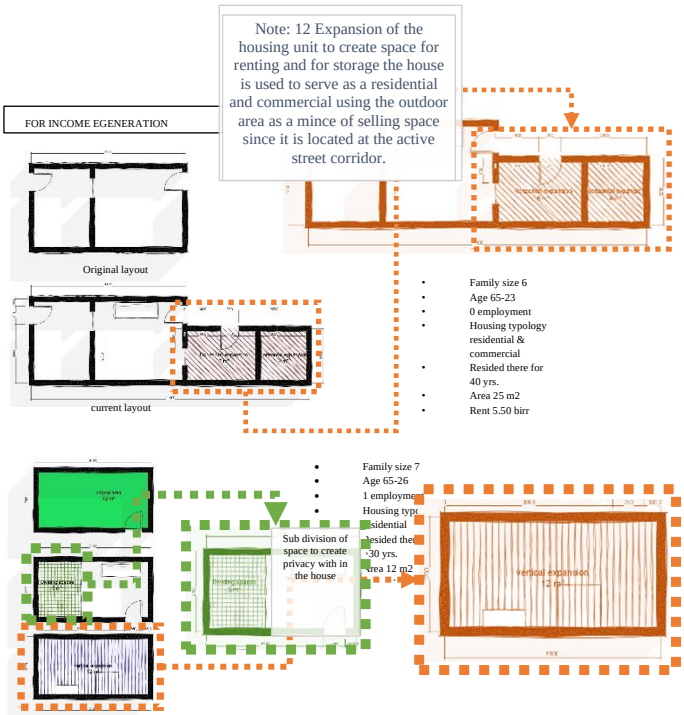
Multi generation families live in small confined quarters not fit for purpose. There is lack of basic amenities such as bathing, laundry, heating and cooking facilities.

D. *Material*

Dwellings were found to be non-permanent and poor-quality structures and are often made with perishable construction materials (wood and mud).

E. *Spatial functional arrangement*

The space is very small in relative to the residents causing the area to be very crowded.



Note: 7 Vertical expansions to allow for income generation It serves as rental bad overnight. The roof of the house has been lifted a little 1 meter to create enough space for the additional area so that inhabitants can stay their comfortably.

F. Informal add ons

Most of the residents have lived here for over 30 years, small self-built add ons have arisen in the courtyard. These add ons are used as toilets, kitchens, storage units and even bedrooms for new family members or tenants. The architectural quality of the courtyard residential quality of the court yard and residential interior have declined dramatically.

G. Dense and fragmented courtyards

Many of the court yards are occupied by many families as can be seen in fig*VI-1*.

Figure VI-2 Dense and fragmented courtyards

H. Social gathering areas

There are very little to non-spaces for social events: wedding and mourning and a space for children playing and space for cloth washing and blow drying; grain and spice drying

Figure VI-3 out door

VII. EXISTING ISSUES THAT INFLUENCE HOUSING CONDITION IN THE INNER CITY OF ADDIS ABABA

The Inner city has great housing issues. It is also the oldest part of the city which is characterized by dilapidated housing, high densities of buildings, the crowding of large numbers of people into those buildings, lack of space between houses (as a result of informal add ons), substandard housing, and acute environmental and sanitary problems. The inner city is characterized by the existence of informal settlements. This is resulted because of the migration of people into the area which is causing the area to be densely populated and also the lack of affordable housing.

The issue faced in the inner city is not space deficiency but rather a functional deficiency. In the case area, it is found out that the problem is people are adding more functions to housing. The housing in the inner-city unit does not exist as a unicellular activity but serves as a multi-cellular activity. The space is occupied by people who are not necessarily part of the family. The children do not seem to leave the dwelling once they grow up, they create their own family and stay in the dwelling units this results in the existence of multi generation family and relatives to live in the same compound and other people who want to be accommodated in the compound usually reside in the housing in the inner city this creates over crowdedness. The need for extra amenities also causes the overcrowding of the space. Therefore, indoor space deficiency is created because of those issues those points should not be neglected but rather accommodated in the space. The spatial requirement of the dwellers must be given attention. The Kebele houses should be provided with spaces that can accredit the essential activities of residents' spatial, social, and economic sustainability of households in the inner city.

VIII. SPACE ERGONOMICS AS A TOOL FOR IN-SITU REHABILITATION OF HOUSING

1) The housing issues in the inner city can be resolved by giving attention to the spatial requirement of the dwellers. The Kebele houses should be provided with spaces that can accredit the essential activities of residents' spatial, social, and economic sustainability of households in the inner city. The residents in the inner city of Addis Ababa have come up with multiple ways to appropriate the space and dwelling to accommodate their spatial and economic needs. So as to appropriate the space in the dwelling to accommodate the household income generation and improve their family's livelihoods, so experience should be taken from the society and by making it formal.

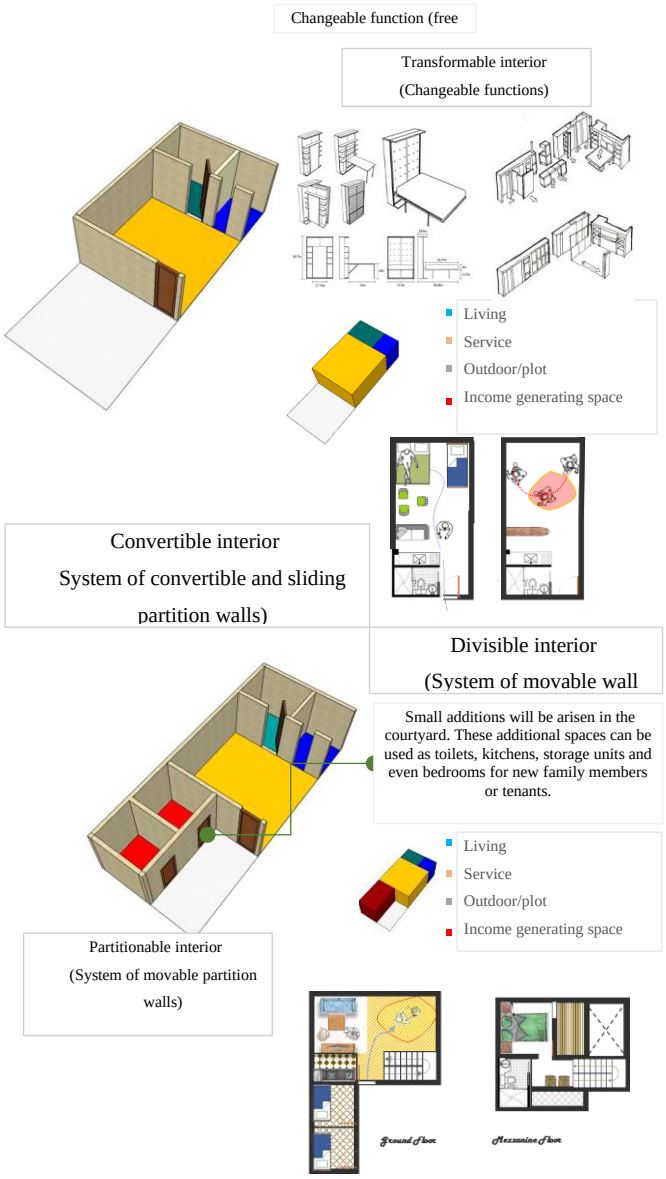
2) The concept of space ergonomics must be applied to the housing units. The different types of design flexibility (Adaptability) approaches should be practiced in the design these techniques include, the provision of multi-use spaces, the spaces should be flexible enough to be redesigned which allows for changing the layout of the user units in a building and the functions of the user units in the building. The layout should be easily transformable by change of shape and arrangement of spaces, convertibility by allowing for changes in use within the building, expandability by facilitating additions to the quantity of space in a building which may be achieved through an increase in volume or capacity. The increase in capacity can be achieved by inserting an additional floor in a building, which does not necessarily increase its volume. There should be a connected ability in which a series of adjacent rooms can be connected through sliding wall panels or doors. The use of a Partition wall can help the possibility of splitting up, rearranging, or combining different spatial units in a simple way. The materials, assemblies, and systems selected should require less maintenance, repair, and replacement and should be durable and adaptable.

3) Since most of the space is small it should be multi-functioning there has to be a possibility of using space, furniture construction, or installation components for several functions. Materials and components from any dismantled building should be as reusable or recyclable as possible.

4) The plot size should be enlarged through an expansion through horizontal and/or vertical. The ratio of the house to commercial activity should be determined so that the degree of freedom when making a design is very clear.

5) Activities with common practice shall be overlapped or they should be shared. If the households perform similar activities and if they want to work together, they should be allowed to transform their housing unit as per their desire.

6) The frontages areas of the housing unit with potential such as road access should give more value to commercial activities has to be integrated in order to enhance the living conditions of the dwellers. The study recommends a strong policy change most of the regulations written on the policies are old so they need to be up to date, the policies need to be more flexible.



Variable features of partition walls

Partitions that allow flexible planning must have the following characteristics:

- easily applicable; produced in standardized sizes; easy to remove the remnants of dismantled partitions in adjacent components (such as floors, ceilings, facing walls, and fixed partitions) Any traces;

possible to coat them with different materials and change the color and texture of the surface according to the space requirements and the personal taste of the user; They must be storable.

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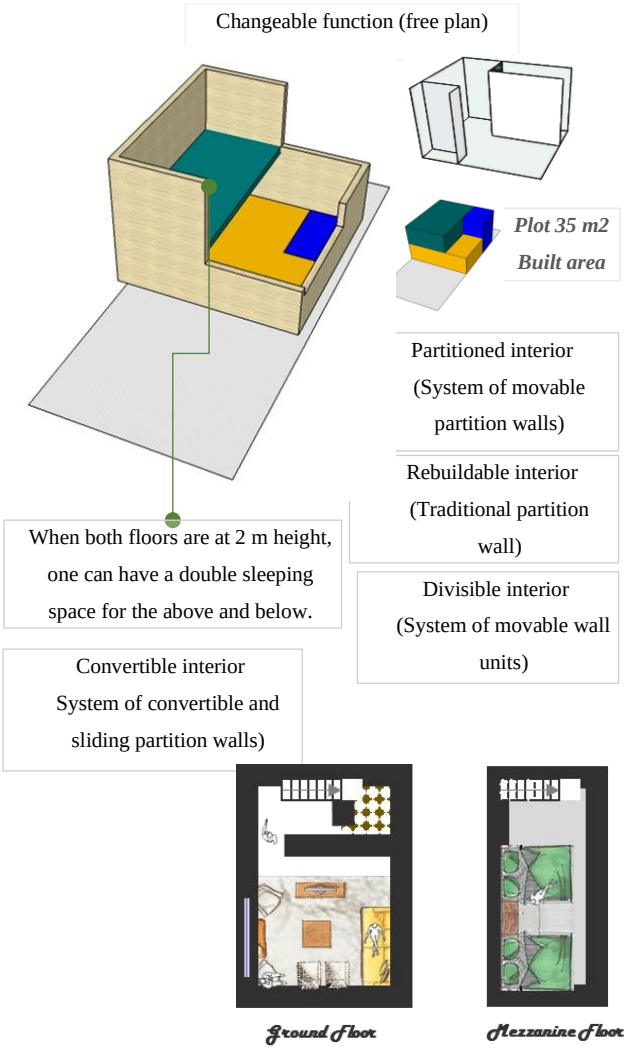
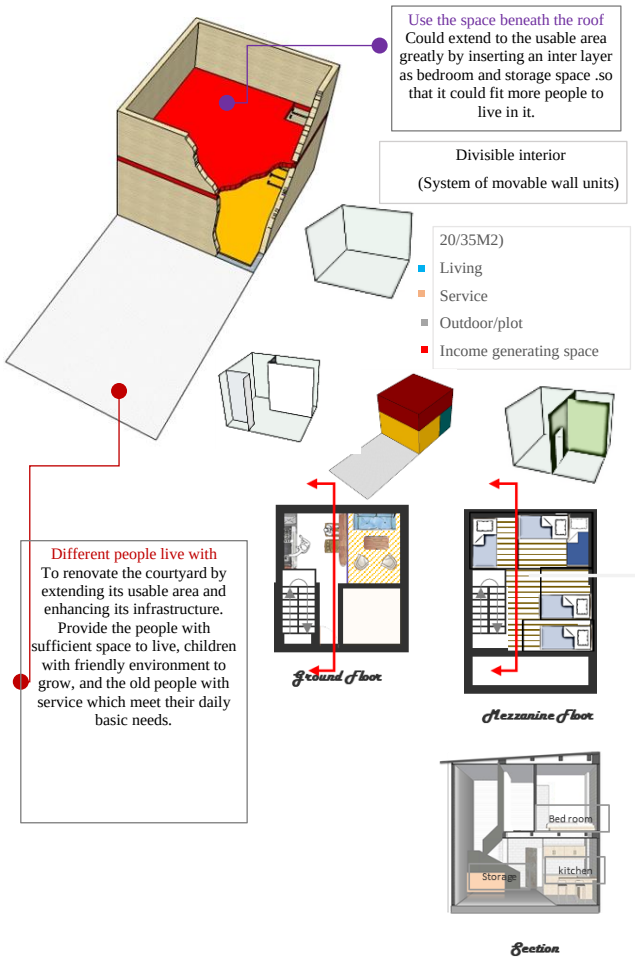
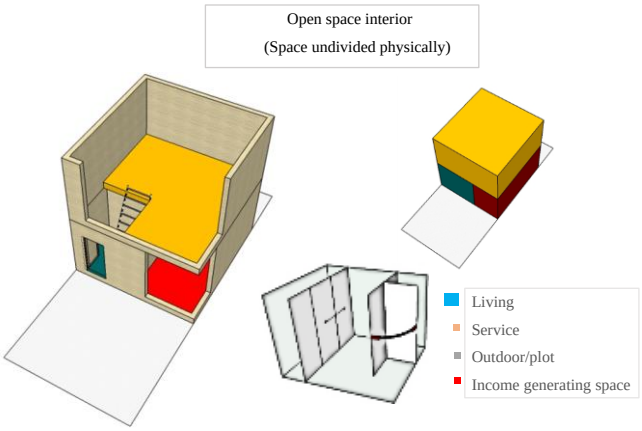


Configuration of the supporting structure

To obtain maximum clear space in the plan layout, steel or pre-stressed reinforced concrete floor systems and components are to be preferred.

- Clear ceiling surfaces
- Beams must be hidden in the exterior wall axes or fixed infill wall axes.
- All structural elements must be located at the exterior of the layout to create unobstructed space within the floor plan.
- The plan layout should not have room divisions, but rather allow for unlimited unobstructed clear space that can be freely arranged.





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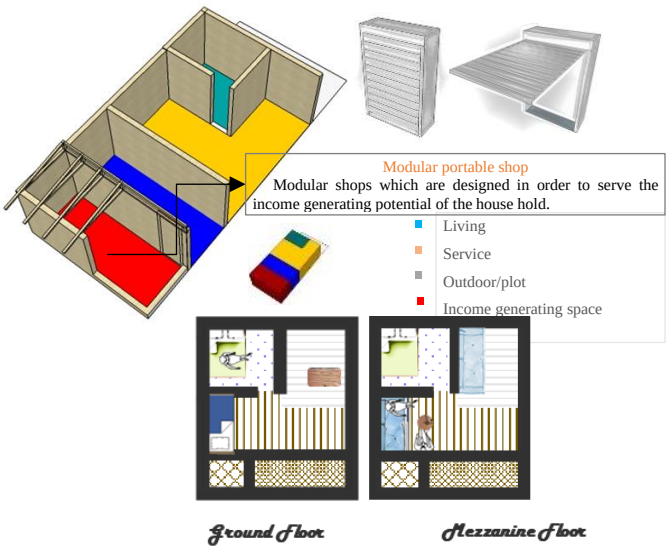

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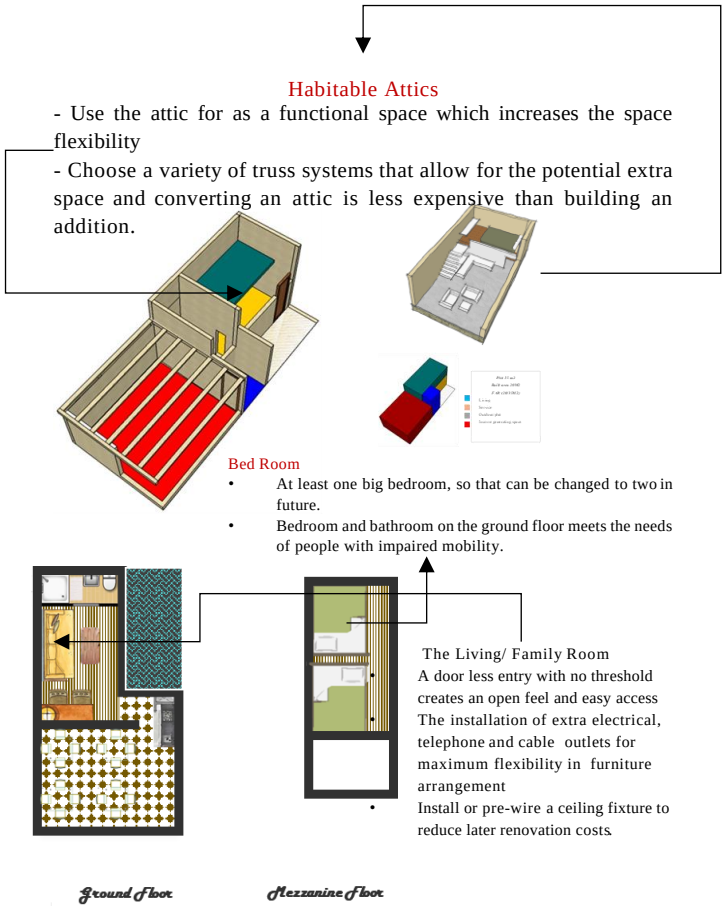

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