EVALUATION AND DEVELOPMENT OF HOUSING DESIGN
Analytical study on detached houses' plan of Gaza city
住宅デザインの評価と発展の方向性
ガザ市の戸建住宅平面の分析

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The designing approach of current housing units in Gaza city has been misled by several public and private companies, contractors, and even people themselves; hence their technical demands and attitudes are focused precisely on costs, forms, and aesthetic rather than climatic and social comforts. To improve the approach, an analytical study of detached houses where people design interior spaces to comfort their thermal and cultural demands has been evaluated. Herein, concepts of Analytical Hierarchy Process have been used in illustrating diagrammatically distributed spaces. Accordingly, several climatic patterns of the summer, winter, and summer-winter are found. Moreover, diagrammatic distribution of modern houses is developed by the concepts of traditional houses in order to set a significant design for future detached, collective, and cooperative housing.

Keywords: Gaza, detached houses, Analytic Hierarchy Process (AHP), Diagrammatic distribution, Climate.

1. Introduction:
Gaza is a small city of 45 km² located in Palestinian Territories Fig 1 and located at 34°N° longitude with 31°E° latitude. It has several severe climatic problems through the year, the monthly mean high air temperature is 31.2 °C in a typical summer, and the monthly mean low air temperature is 6 °C in the winter that inevitably affects housing designs. Significant approaches can be realized by overwhelming problems of housing layouts that are derived by climate and culture. In the same context, Gaza is known by its densely populated area with a population of 492,621 (estimated in December 1999). As a result of land shortages and high population density, high-rise buildings with intensive apartments have been built with widely western planning to lessen overcrowding while climatic and cultural issues were abandoned. This hasn't solved housing crises but on the contrary has worsened the situation and its negative impacts on the social and traditional life style. To improve the approach of planning in terms of sustainability, an analytical study for detached houses of post-British mandate's period has been done. Historically, Gaza has been controlled by many empires, including the Pharaonic, Babylon, Persian, Hellenistic, Roman, Byzantine, Islam, Crusaders, Mamluk, Ottoman, British, Egyptians (1948-1967), Israeli (1967-1994), and finally the PNA (1994 until now). Accordingly, characteristics of modern detached houses can be found and then be corrected by basic plans of traditional houses, in order to positively set solid theories for future housing planning. Finding a flexible design that can satisfy human comfort is an urgent demand in a predominantly sustainable architecture concept.

![Fig.1. Geographic location of Gaza city](image)

2. Purpose of the study:
The study aims to achieve a positive guidance for future housing planning through the following means:
2.1 Find out characteristics of modern design that identify housing patterns. This reflects satisfaction of people that should be carefully considered.
2.2 Find out an extendable approach by applying positive concepts of indigenous spaces into process of modern design. This can strongly supply climatic and social designs for future enterprises.

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3. Research methodology:

Generally, a field survey of 248 respondents has been conducted to the study. Based on housing types responses were classified into three types as detached house, flat units, and villa of two floors houses. Detached houses have been constructed by people themselves in order to achieve thermally and socially comfortable designs. Those houses, which represented about 46% of the field study, i.e. about 115 respondents of 17, 48, and 50 houses of Egyptian, Israeli, and Palestinians times consequently, have been analyzed. Distributing and collecting data had several problems derived from the internationally known conflict of the Middle East between Israeli and Palestinian sides. To analyze the data of the questionnaire, concepts of Analytical Hierarchy Process (AHP)\(^1\) has been used. AHP is designed to cope with both rational, and the intuitive to select the best from a number of alternatives evacuated with respect to several criteria. In this process, a simple pairwise comparison is carried out to get judgments, which are then used to develop overall priorities for ranking the alternatives.

The AHP both allows for inconsistency in the judgment and provides a means to improve consistency \(^2\). Herein, to find housing typology in terms of characteristics of current detached houses, the research has focused on analyzing four criteria Fig.2 as land issues, ground floor’s activities, orientation of indoor spaces, and standards of spaces. Those criteria have been subdivided to several alternatives. Conducting the Matrix-Theory into the analysis, which hypothesizes people’s intensions and satisfaction of current orientation and activities. The processes of calculations were to select the best two numbers of alternatives such as the east, west, north, and south in case of orientation of indoor spaces. First and second priorities represent mainly common satisfactions of people on some directional locations. The results of AHP are compared with the actual plans, which were collected from the study, and proved workability of AHP on this context.

4. Detailed characteristics of modern design:

Statistics, which were done in mid 2000, revealed that household size was approximated to 6.9 persons and 50.20 % of the population is less than 15 years of age\(^3\). Open spaces are urgently needed for absorbing children’s activities and lessening overcrowding in a house; hence it is noticed from the analysis of the questionnaire that almost one third of families commonly share housing units horizontally or vertically in an extended manner. Several reasons are behind it such as shortage of lands and deteriorating economic conditions, and cultural reasons. As well as the head of the family has used to construct his generation’s housing units, which in turn, creates a great pressure on his/her financial and cultural conditions that negatively worsen image of architecture. On the other hand, about 45% of the people have a low-income salary with an average income $350-500 per month; hence about 55% of the people are public and private employees. This results simple housing forms with about 50% of incomplete buildings as a common phenomenon. Current detached housing units vary in their occupancy density, family type, house tenure, construction type and period, location, size and even differ in terms of income of its occupants\(^4\). Concrete materials have composed about 87% of the structural volumes of detached or semi-detached houses. Herein, challenges are set for architects, planners and specialists to an extent of what type of a house design is needed. Enhancement of cooperative housing is worthy and valuable; hence it can reflect a positive image of architecture and socially strengthen mutual relations.

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**Fig.2 Housing patterns in terms of characteristics**

**Fig.3 Size of major plots**

**Fig.4 Plot description**

Abbreviations: rectangle (R), square (S), irregular (I), East (E), West (W), North (N), South (S), first priority (P1), second priority (P2)

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4.1 Plot issues

People own more than 85% of housing plots due to several reasons as it represents a safe investment, security and status, at the time almost no other opportunities. At Fig.3 highest and constant percentages of about 48% of plot areas during three periods have been ranged from 150 to 250 m² to accommodate extended families with an average of about 9 people in a family. Rectangular plots have been weighted to represent their first priority Fig.4, and most of these plots have a commonly shared elevation length of about 10 to 15 meter. This priority reflects a newly practical definition of high-density districts, where people feel satisfied of the form. Shared plots represent a significant percentage of about one quarter of the study. The shared plots have limited rules to family members or relatives only due to required privacy and cultural issues. About half of the sample was a yard house and maximum numbers of yards have an area of less than 20m². Generally, most yards are oriented to northwest and to the east Fig.5 to represent consequently first and second priorities. These yards functionally act similar to old courts, where climatic and socio-cultural aspects have been considered. They tend to differ in size and shape according to the geographical location, type of climate, property shape, and location, resulting activities, and socio-cultural relations. Climatic reasons behind these directions; hence northern yards are arranged to gain immense wind for enhancing cooling loads inside spaces. Southeastern yards are absorbing sunlight to developing outdoor conditions. In the study, it is noticed that a guest room is closer than the living room to the yard due to the required privacy; hence both yard and guest rooms represent a semi-private place; i.e. guest can easily use both of them while inhabitants can’t use them in case of guest’s existence. Respondents who have a yard house could describe activities of yards as follows: 1) It is a place for chatting and relaxing with the family where shaded areas are occurred in summer. 2) It is a place for children to discharge their energy and enjoy the weather during the daytime. 3) It is a place where you can welcome your guests. Other respondents who don’t have a yard have explained reasons behind it as, firstly I have inherited the house without a court but I wish I could find a way to have a court, and secondly the regress system, which has been used by the municipality, has weakened the use of courts. Herein, development of yard-house features into future cooperative housing is urgently needed due to the previously mentioned cultural and environmental issues.

4.2 Ground floor’s activities

Ground floors of detached houses embrace several functional types within the space. Housing units (HU), an open space that is known locally by a shed (SH) and internationally by pilotis, commercial stores (CS), and mix-used spaces (MU) form ground floors with different percentages. The size of families defines what type of spaces is needed. In some cases there are two or even three functional types on the ground floor. It is noticed that mostly occupied spaces are housing units Fig.6A that represent a first priority. This is due to shortages and high prices of lands, and a high density of population that gives almost no space for individuals. A newly architectural shed is naturally created and increased during times. The shed is a multi-used space where some cultural and functional activities can be done. Children can enjoy their outdoor activities especially in the summer. The shed is a flexible area that can be changed easily at urgent times into housing units, commercial stores or even a mix-used type Fig.6B. The commercial and mix-used types have been decreased in the study especially at Palestinian times where economic conditions have become stable. However, majority of the people are employees and their mainly future extensions on housing units or open sheds. To sustain planning, adopting both two priorities (housing units and open spaces) is urgently needed for adults and children.

4.3 Living environment and spatial distribution

People are negatively unsatisfied with their tackling, hence feeling uncomfortably cold and warm during the winter and summer. Herein, a specific analysis of spaces’ orientation and indoor activities has been done to show main characteristics of spaces. It is found that four zones of guest, living, sleeping, and service areas form indoor spaces. Investigations on previous issues help the evaluation processes of designs.

4.3.1 Guest Area (GA)

The guest area consists of a guest room in addition to its required spaces as a special toilet and sink. Based on the analysis, it is found that more than about 90% of houses have a special room for guests only. This space has to match the culture of Moslems, where privacy and separation between formal guests and inhabitants are a must. Close relatives can be welcomed in living or guest areas. Activities of about 60% of the sample that occur in the guest spaces are firstly to welcome foreigners only, while the rest is devoted to living and cultural celebrations. Basically, western style furniture represents a percentage of about 55% of the sample, while Arabic style is noticeably increased of about 30% due to its simplicity and rearrangement within the space. It is advised to enhance the living style by flexible furniture to lessening family density within the space. AHP has been utilized to determine the actual directions of the guest area Fig.7 and it is found that first and second priorities are consequently positioned in the west and east. Dealing problems of the summer more than the winter has been clearly noticed.

4.3.2 Living area

The living area consists of a living room in addition to its required spaces such as corridors and balconies. From the analysis of the study, it is mentioned that activities, which occur inside the living space, are mainly enhancing family communication, informally used as a guest space for close relatives, dining space, and a place for practicing cultural activities. This space has been positioned mainly beside the entrance, which has two opposite routes for the living and guest rooms. In the same context, a kitchen has been set beside the living space increasingly, where people have meals within the space. On the other hand, positions of the guest rooms beside the living rooms are decreasing from the time of Egyptian until now due to various
reasons as required privacy and flexibility inside a house. A wide utilization of light Arabic futons in the living spaces has given a flexibility of the living style. The location of this space has been performed first and second priorities Fig.7 consequently to the west and east due to the required wind of the summer. It is advised to enhancing the living environment by previous activities, except the direction of the space, has to be discussed deeply to deal also with the winter problems; hence people spend their times inside it during the winter.

4.3.3 Sleeping area (SA)

The sleeping area consists of bedrooms and its required services. According to the analysis, it is found that about 50% of the sample has an average of three bedrooms for parents and children (female and male). A percentage of more than three bedrooms is approximated of about 20% of the sample. Most master bedrooms have been furnished western style, while children's bedrooms by Arabic futon style in order to give satisfaction on arranging interior spaces easily where the numbers of children are numerous. Children's bedrooms represent their first living space where about 70% of the sample's children spend more than 8 hours daily inside bedrooms that are managed to deal with activities of study, dining, and living issues. The directions of bedrooms are set due to many climatic and cultural reasons, and street location. Throughout the analysis Fig.7 it is found that first and second priorities of the spaces' positions are consequently positioned in northwest and the east. Herein, housing design deals with problems of the summer rather than the winter. Connecting a flexible indoor space that fit indoor activities with outdoor is a significant demand for achieving sustainability during the year.

4.3.4 Services area (KB)

The service area consists of kitchen and wet areas such as a bathroom or toilet. Kitchens are devoted to serve directly people in living spaces where people practice different activities within the same space. Throughout the analysis, it is noticed that about 78% of the houses don't have a dining room. The living space or bedrooms for meals or drinks are commonly used. Thus, close spaces to the kitchen are arranged consequently, the living space, bedrooms, and finally the guest space. At Egyptian times, bedrooms were far away from the kitchen but currently located beside it. Kitchens should be set beside the living spaces of the family and children. AHP has been utilized to determine the actual directions of the kitchen Fig.7 and it is found that first and second priorities are consequently positioned in the east and south for the need of sunlight.
4.4 Standards of spaces

It is noticed from the analysis that decreased percentages of a house area of 150-199 m² have been noticed especially at Israeli times where extension of properties was restricted. Percentages of a house area of 100-149m² have been kept constant during the three times though several cultural and financial changes have been occurred. This area is very likely to be satisfactory where satisfaction on a house area has been classified into two priorities by asking people to express comfortably satisfied areas of indoor spaces Table 1. This result implements corrective measurements for a pleasant occupancy of future housing units. First priority that gives satisfaction on spaces has been directed to utilize smaller housing units with bigger open spaces. It is advisable to use this approach to get satisfaction of housing units.

5. General classification of housing planning:
Forwarding the direction of each period, a real extension can be found in the distribution and orientation of spaces Fig 7. This extension mainly clarifies two priorities of current planning that create climatically two separated summer and winter patterns. It is known that the prevailing wind during the summer comes from the northwest. This action has created summer patterns where most living spaces are oriented to face northwest during the three periods. On the other hand, same spaces have been set to the east and south, which in turn created winter patterns that tackle problems of winter. Directed sunrays can easily penetrate the spaces to maximize healthy living environments.

<table>
<thead>
<tr>
<th>Name of Spaces</th>
<th>First Priority (m²)</th>
<th>Second Priority (m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entrance hall</td>
<td>5-8</td>
<td>8-11</td>
</tr>
<tr>
<td>Yard</td>
<td>10-20 or &gt;40m²</td>
<td>&lt;10</td>
</tr>
<tr>
<td>Kitchen</td>
<td>9-12</td>
<td>12-15</td>
</tr>
<tr>
<td>Storage room</td>
<td>5-8</td>
<td>&lt;5</td>
</tr>
<tr>
<td>Guest room</td>
<td>14-18</td>
<td>18-22</td>
</tr>
<tr>
<td>Living room</td>
<td>15-20</td>
<td>20-25</td>
</tr>
<tr>
<td>Master bedroom</td>
<td>15-18</td>
<td>12-15</td>
</tr>
<tr>
<td>Secondary bedroom</td>
<td>12-15</td>
<td>15-18</td>
</tr>
</tbody>
</table>

Fig 8 Diagrammatic patterns of main priorities of distributed spaces
5.1 Planning patterns based on priority hypothesis

Architectural patterns of houses are a circumstance of repeating some characteristics of constructional elements or spaces regularly. Hypothesizing a method for housing evaluation is an urgent issue that guides sustainable planning of housing sectors. The evaluation of housing has focused on achieving most commonly oriented spaces in houses that reflect satisfactory. First, second or even third priorities of preferred spaces that represent peoples' satisfactions on spaces during the three times have been individually assembled. It is noticed that housing patterns have been basically classified by summer, winter, and summer-winter patterns that are based on orientation of living spaces. The priority of constructing a diagram has been altered during times; for example, the first priority of planning has been focused on summer patterns that have been encouraged during both Egyptian and Palestinian times Fig.8. In the same context, summer-winter patterns has been obviously encouraged at Israeli times where environmental planning was newly integrated to housing designs. It is being shown that the architecture of Gaza has neglected winter pattern that has affected people satisfaction negatively. The authors believe not only summer pattern have to be integrated to the planning but also winter patterns where both of them can form summer-winter patterns with flexible zonings, which can be easily used during the year by occupants. Current housing planning and designing is described at Fig.9.2, where first priorities of directed spaces are devoted to deal the summer problems than the winters'. Those characteristics were commonly found due to some climatic misunderstanding. To achieve a newly future design, current planning has been corrected by traditional architecture planning ①. Herein, zonings of commonly oriented spaces of modern and traditional housing units have been combined together Fig.9. The theory of correcting a design is based on joining both Fig.9.1 and 9.2 to represent newly future spaces within a compound design Fig.9.3. Accordingly, it is noticed that the west and south directions have living areas, which are mainly directed to get much northwest wind. The living area of west direction has been neglected Fig.9.4 because it deals only with summer's problem. The southern living area is connected with a northern court through a corridor in order to absorb summer's wind and to gain sunrays of winter. Thus, keeping southern positions for living spaces is valuable during the summer and winter. Throughout the analysis, Fig.9.4 has been developed to Fig.9.5 where people strongly recommended having opposite directions for living and guest areas in order to achieve privacy and security as mentioned at 4.3.2. Moreover, people have insisted to set their kitchen beside the living and sleeping areas that make them feel comfortable. The living and sleeping represent a special living environment for all family members as mentioned at 4.3. It is recommended to combine them into one space during daytime and separate them during nighttime where there is almost no livable activities Fig.9.4. This design can be fulfilled by utilizing flexible and functional partitions that can afford valuable open spaces. These spaces clearly enhance solving problems of high-density areas. In summer, a family can enjoy and spend times at northern open spaces where cross or passive ventilation can be applied to encourage activities of indoor spaces positively. Living areas would solve problems of winter by exploiting sunrays that enhance indoor spaces warmly. This approach decreases overcrowding of extended families and increases thermal and social comforts. Detached and cooperative housing can develop and integrate these distributions into design and planning as shown in Fig.9.6.

Abbreviations: yard (Yrd), court (Crt), entrance (Ent), corridor (Crd), kitchen and bath (KB), sleeping area (SA), guest area (GA), living area (LA), computer corner (Cp), storage (St).

Fig.9 Development of current planning by concept of old housing design for future housing units
6. Conclusion:
To have a complete and successful approach, supporting residences with fundamental characteristics of traditional and modern architecture is highly recommended. The previous analysis is arranged for different issues as follows:

6.1 Distribution of spaces
1. Advanced diagram of Fig. 9.5 shows clearly spaces' distribution that possibly satisfies people; hence spaces were arranged to fit their satisfaction.
2. The importance of court or yard planning in housing units and its connections with the previous mentioned spaces based on cultural and environmental issues have shown its positive meanings.
3. Housing units shown in Fig.9.6 can be effectively arranged into cooperative or collective housing in order to get satisfied requirements. Combining two units to share an open space vertically is strongly enhanced for social and environmental issues. From the previous interpretations, it is noticed that traditional plans could represent a forward reference, which has been permanently developed with people's satisfactions.
4. Beside this study, respondents were asked to show the necessity of sitting a new tech-space in a house to communicate smoothly technological features as computer, fax, printer and so on. Respondents of about 85% have shown their interest on that issue. As mentioned at 4.3.3 that children's bedrooms represent their first living space where about 70% of the sample's children spend more than 8 hours daily inside bedrooms that are managed to deal with activities of study, dining, and living issues. Thus, it is advised to integrate the sleeping area (SA) with a new tech-space (CP) that can be easily shared by family members Fig. 9.6.

6.2 Standards on housing units and plot areas
1. Table.1 shows a significant meaning of standardizing indoor and outdoor functional spaces. It shows that the first priority has a smaller area than the second priority to indicate those respondents' problems aren't limited to a house's scale. Respondents show their interests of having a larger outdoor space to enrich the living environment of children actively. It is advised to enhance houses with northern open spaces and with southern living spaces for better living environments as shown in Fig. 9.6.
2. To enhance the living environment of extended families where numbers of children are numerous, using flexible spaces by using movable, flexible, and functional walls is highly recommended Fig. 9.6. These walls can be freely changed based on types of activities.
Generally, it is strongly recommended to activate previous characteristics of traditional and modern architecture into future processes of planning and construction to get close to the required sustainability in terms of culture and climate.

Acknowledgement
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Footnotes
1. The authors would like to attach the following example of the calculated priorities of Fig.6A during the Egyptian times.

<table>
<thead>
<tr>
<th>Egyptian times</th>
<th>Numbers CS</th>
<th>HU</th>
<th>SH</th>
<th>MU</th>
<th>Eigenvector Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial Stores-CS</td>
<td>(05)</td>
<td>14/5</td>
<td>14/2</td>
<td>14/3</td>
<td>(CS<em>HU</em>SH*MU)*1/4</td>
</tr>
<tr>
<td>Housing Units-HU</td>
<td>(14)</td>
<td>14/4</td>
<td>14/2</td>
<td>14/3</td>
<td>(CS<em>HU</em>SH*MU)*1/4</td>
</tr>
<tr>
<td>Shed-SH</td>
<td>(02)</td>
<td>2/5</td>
<td>2/4</td>
<td>2/3</td>
<td>(CS<em>HU</em>SH*MU)*1/4</td>
</tr>
<tr>
<td>Mix-Used-MU</td>
<td>(03)</td>
<td>3/5</td>
<td>3/14</td>
<td>3/2</td>
<td>(CS<em>HU</em>SH*MU)*1/4</td>
</tr>
</tbody>
</table>

2. The following diagram represents traditional houses of Gaza city. This result was carried with reference No.4 that mainly focused on achieving mostly popular distribution of historical plans. The process of drawing the diagram from the plan is shown as follows:

References

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5. プライオリティ理論による平面計画

ガザにおいて、サスティナブルな視点から新しい住宅の評価を特定することが緊急の課題である。そこで、本研究では、住宅の評価を満足度が反映される住宅内のリビングスペースの方位に焦点を当てて、3つの時代それぞれの空間のプライオリティを絶対化することで、各時代のリビングスペースの方位が変わかった。そこから、住宅パターンが年間、冬型、夏型、冬型に分類することができ、それらが

リビングスペースの方位を基準に配置されていることがわかった。しか

し、管理者は夏のバターンのみを考慮だけでは不十分であると考え

ている。夏だけではなく、冬や夏の一冬のバターンにも柔軟に対応したソーニングを整備する必要がある。そして、これらのアプローチから

伝統的住宅の平面計画と現在の平面計画を検討し、設計の方法を検討し、住宅の問題を解決することができる。これを改善するために、イギリス統治時代以前の

戸建て住宅を分析する。そして、それの結果に応じて現在の住宅特徴を

明示し、伝統的な住宅の要素を取り入れた新しい住宅計画の提案を

目的としている。

6. まとめ

上記の分析をふまえ、本研究を以下の通りまとめた。

6-1. 空間の配置

1) 図9.5は居住者が満足する空間の配置を示すことができた。

2) 住宅ユニットの中に面積や方向を計画、及びそれとの他の部位の

関係に重要な意味を持っていることがわかった。

3) 住宅ユニットは、コレクトリファクスやコアポリティックです

同じコンセプトを用いることが可能で、オーバースペースを共有する

形で2つのユーティを上下的つなげることは、住環境や社会的な環境

を向上させる上で望ましい。

4) コンピューター、ファックスやプリンタなど新しいコミュニケー

ションツールへの要求があることがわかった。さらに、それらの住宅

内のコミュニケーションが取られやすい場所に配置することに対する

必要が感じられた。75%の人々が要求しているということが明らか

になった。小さいスペースをリビングスペースのまわりにまとめて配置す

ることが、家族での共有を容易にすることが図9.6からわかる。

6-2. 標準的な住宅ユーティとその要件

1) 表1から、住宅が小さくても、すそ大きなオーバースペースを

持つ住宅は、2世代居住にとって良い住宅である。ただし、内部空間を

共有することを文化的な観点から考えることは、重要な意味を持ちこ

うことわかった。

2) 住宅ユニットの近くで日常の生活を遂行することで満足を得るため

には、図9.9に示す住戸計画アプローチに沿って検討することが望ましい。

3) 最も重要なのは、住宅が小さいことではなく、オーバースペース

が必要なことである。私は、上記の特徴を将来のプランニングや構造

のアプローチに反映させることを強く推奨する。なぜなら、これ方が今

後の文化や気候の観点から、持続的な計画論や計画手法を確立する上

で重要だからである。