Urban sustainability and market typologies: lessons from Tabriz Bazaar

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ABSTRACT: The market is an essential component of urban form. Contemporary shopping malls can benefit from the inherent efficiencies of traditional markets. This paper addresses the development of sustainable models of market typologies based on a specific case study, the Bazaar of Tabriz in Iran.

As one of the biggest historical covered markets in the world (Moradi and Nassabi 2007), it remains an effective trading centre in the city. What are the lessons that make Tabriz a sustainable urban typology and what lessons can we draw from its spatial and operational structure?

To address this question, the paper presents two analytical studies of the urban and building morphology of Tabriz. First, the paper presents an analysis of the urban and social structure of the market based on Lynchian analysis. Second, it provides an analysis of the thermal, ventilation and lighting principles used in the buildings of the market and how they respond to the extreme climatic conditions of north-west Iran.

Rainfall and snow in one side and hot summers in the other, give the buildings in the city really critical performance in terms of life span during the years of operation.

The main target in this case study, is to illuminate the urban typological clarifications in the Bazaar of Tabriz, which will elucidate how parallel links between urban morphology (land cover) and urban typology (land use) in defined urban planning can form a sustainable urban space, and moreover, how the case of this study can be an energy efficient complex with its own urban morphology.

The lessons of Tabriz for the development of contemporary markets are summarised in the paper and need to be addressed at two scales, namely the urban scale and the scale of the building.

Keywords: sustainability, Tabriz bazaar, urban morphology, urban typology.

INTRODUCTION

The issue of energy efficiency is of increasing importance in delivering sustainable architecture. For instance, leadership in energy and environmental design (LEED) and US green building council (USGBC) have invested in energy efficient buildings and construction to reduce their environmental impacts and increase innovation (Faucette 2006). In this study, the word sustainability is understood not only as energy efficiency but also in the environmental, social and economical sustainability of the urban space.

Vernacular architecture benefits from inherent energy efficiency. This does not necessarily mean that all sustainable attempts should imitate vernacular architecture, but it is imperative to study traditional form for a number of reasons. Sustainability of buildings, which are operating for decades, centuries or even thousands of years (Maver and Petric 2003) can be easily established in terms of their lifecycle, longevity and value to society. There are two major criterion in this study; “Urban typology” and “Urban morphology” as a determinant of sustainability. These two deliberations play very significant role in discerning the methods, which vernacular architects has chosen in order to engage natural resources for the operation and the maintenance of the aggregation.

Tabriz (38.13°N, 46.28°E and 1364 m asl) is a city in north-west of Islamic Republic of Iran with cold-mountain climate (Gholipoor 2008). After the earthquake in 1780 (7.7 Richter scale), when about 40,000 died, (Ambraseys and Melville 2005), local architects decided to develop an environmental friendly market and could be sustained through climatic, geographic and social changes. The study of urban typology and urban morphology in Tabriz bazaar makes these organic principles clear in the complex and is very useful in understanding the development of sustainable urban form.
1. URBAN TYPOLOGY OF TABRIZ BAZAAR

In terms of urban typology, this study looks at the value assessment of the urban space in investigation of the urban design elements. The urban typological study identifies the dominant elements in Tabriz bazaar, which helps to understand the urban structure of the complex. Such a model of urban design contributes energy efficient factors and benefits from natural resources in the bazaar of Tabriz.

1.1. Evaluation of urban space elements in Tabriz bazaar

Following Lynch, the elements of the urban space can be categorized by five types; paths, nodes, landmarks, edges and districts (Lynch 1960). This paper defines the urban typology in the bazaar of Tabriz by using these five elements. Tabriz bazaar is very large in scale and organic in its architecture. However, it is clearly very well disciplined in its plan. The estimated area of the all bazaar is approximately 195,000 m² (Tabriz Municipality 2003) and in this extensive area rather than trading there are a large number of varieties in functions (mosques, public baths, seminaries and etc.). The harmony in this complex is based on the function of the spaces and this is the reason why in a well organized complex, it is easier to control the links, divisions and developments easily. In order to understand the structure of the market, the essential information has been developed through a CAD model of Tabriz bazaar (Figure 1).

1.1.1. Paths in Tabriz bazaar

Paths in the bazaar of Tabriz are mostly covered streets which are named as “rasteh” in native language (Moradi and Nassabi 2007). Functions along the path are an important factor which makes it prominent (Lynch 1960). For instance, the footpath level in the jewellery market (4-5 : C-D in figure 1), which is called Amir Bazaar, is almost two steps lower than the floor finish of the shops for security reasons (Moradi and Nassabi 2007).

Furthermore, rasteh paths in the bazaar have the key role in the connective layout of the complex. As is shown in the figure 1, there are two main paths in north-south direction of the bazaar and all other routes in east-west direction are usually short and branching from the main long paths. The roofing structure above the rasteh paths are domed with small openings. Water wells from the City River flow on the floor and local stone flooring and brick pavement are the main finishes in pathway floors. The domes are made by different styles of brick arrangements (see Figure 3).

1.1.2. Nodes in Tabriz bazaar

Definitions of nodes in urban studies vary by the scale of the cases (Lynch 1960). Figure 1 shows nodes in Tabriz bazaar that are in the intersection of the rasteh paths. The directions change in these urban elements and they are the meetings of the pathways. The importance of the space in these junctions deserves more detailed architecture.
and have even big openings in some of the main intersections with decorative shapes and ornaments called “Mogharnas and Karbandy” (Moradi and Nassabi 2007) as is shown in figure 2 (the node on grid 5 in C-D of figure 1).

1.1.3. Landmarks in Tabriz bazaar

According to Lynch (1960), the landmarks are often external elements with various scales and act as markers for people to locate themselves in the urban space. Moreover, landmarks are defined in two categories; firstly making the elements visible from many places (e.g. the Eureka tower in Melbourne) and secondly, making the elements in contrast with nearby elements like a variation in setback or height.

There are both exterior and interior landmarks in the bazaar of Tabriz. As it is shown in figure 1, although the bazaar is a covered area, it benefits from some open spaces and courtyards within the complex. These courts are known as external landmarks in at first contrasts with the covered shops and in second as an aid for people to find out where they are, checking the other meeting routes in the yard. These open spaces also are effective in natural air ventilation and have social functions when there are religious gatherings for example. Furthermore, there are some interior landmarks, which are known because of their significance in the aggregation. For example “Amir Dome” in figure 1 (the landmark on grid 5 in C-D) is known as the biggest and the highest dome in the complex.
1.1.4. Edges in Tabriz bazaar

According to Lynch (1960) despite the fact that "Edges" in plan diagrams look like the paths, they are all vertical surfaces that usually separate distinct areas from each other. Figure 3, which is located almost in the D5 grid point in figure 1 and circled by nodes, shows a typical sample of the architectural edge type used in the bazaar. Despite landmarks, which have less importance and less recognition in this part of bazaar, all other elements of urban space can clarify their type of illumination in the typological elucidations.

Edges in the bazaar of Tabriz Can be known as either interior-interior (II) or interior-exterior (IE) boundaries. II boundaries themselves are divided into two separate types; firstly, II edges in the same districts and then II boundaries in different internal trading domains. The former are mostly the boundaries in two sides of the rasteh and the latter is usually forming the vertical edges of the uncovered courts. Surprisingly, the area of the IE edges in defined external routs (streets, avenues and est.) is insufficient in a comparison with the area of II boundaries. This might be the reason why most of the visitor people in the streets of the block, in which the bazaar is located, are not able to recognise and see the magnitude of bazaar in their daily trip.

As is shown in figure 1, unless the short length of edges in “Allameh tabatabayi boulevard (gridline J), Darayi and Ferdosi streets (gridlines 6-7 and 4) and finally, Shohada and Tarbiat Avenues (gridlines A-C), there are no direct EI boundaries in the complex. This is one of the points that makes this wonder of Architecture undiscovered in the region for tourists.

(Tabriz Municipality 2008)

Figure 4: Tabriz bazaar sketch in 1927

1.1.5. Districts in Tabriz bazaar

“Districts” in an urban space are either internal or external linked and generally characterized large areas, where the bystanders are able to understand the urban structures there (Lynch 1960). As is shown in figure 4, districts in the bazaar of Tabriz are very well defined and separated by either pathways or trading types of the shops. These districts, which are named as Sara (the larger districts) and Timcheh (the smaller districts), are located around the uncovered areas in the bazaar (Moradi and Nassabi 2007). Furthermore, they are limited by rasteh paths in the cover parts of the complex. One of the points that takes attention in bazaar’s districts is that the paths between two different saras or timchehs are usually wider in section and more often there is only one special commercial field in the one district. For example in Amir Bazaar the shops (Hojrehs in vernacular) are just trading jewelleries or in the Mesgar (coppersmith in English) Bazaar the Hojrehs belong to just copper workers. This method is the same in Mozaffarieh (Carpet makers and seller’s bazaar) Sara, Kaffashan (Shoemakers) Bazaar, Kharbar (Provisions) Bazaar and mostly other districts. Indeed, some of the districts are named as the most successful merchant or businessman in the past, like “Mirza Abolhasan Sara” or “Razavi Timcheh”. That is why the extents of internal divisions are very clear for visitors and they can easily identify different trading functions by their districts. Since different types of trading need different urban infrastructures, this separation helps even to operate and maintenance the bazaar easily with less costs.

2. URBAN MORPHOLOGY OF TABRIZ BAZAAR

Urban morphology is the result of the reciprocal links between the urban function and the urban form (Barr, Barnsley et al. 2004). Urban morphology studies in Tabriz bazaar, needs to look at the typical details that forms the overall urban form in bazaar and can be seen everywhere in structure. In the morphological analysis of the case, details of the complex, which are used typically in all architectural design, will be discussed and some samples of the buildings in bazaar, which are benefiting from these typical details, will present the followings;

- Firstly, how effective the dividers are in thermal analysis
- Then, how the roofing system helps to make natural ventilation in the aggregation.

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With these analyses, it would be easier to find out what the simple but very vital techniques are in the complex, which architects made by their design process with architectural details, to form a sustainable urban typology with commercial functions.

2.1. Divider’s analysis in Tabriz bazaar

Dividers and walls in the bazaar of Tabriz are mostly made up of solid local materials like brick and stone. These materials form thick walls of approximately 0.60m to even 1.5m in thickness in complex. The main advantage of this kind of arrangement is to produce a thermal envelope which helps controlling the temperature in hot and cold climates. Moreover, obtaining security might be the other reason to make dividers thick enough to insure safe commercial space at the time. Figure 5 shows the thermal reaction of these dividers in different hours of days in IE boundaries.

As it is clear in the Figure 5, during the day these walls conduct the heat form outside to inside area. In the early hours of the day, when sun rises and the walls are steel cold, both outside and inside areas are in the same temperature. However, the walls start to raise their heat from outside. By passing time (about 4 hours), when the sun heat in outside is going to be maximum, the temperature difference in both outside and inside is the highest rate in the day and the thermal mass is half-warmed in the outside face. In the afternoon, when sun goes to set, the heat spreads in the whole thickness of the wall and reaches from outside area to inside. In fact, the heat passes though the stone or brick walls from exterior to the inside area, but it does not happen until about 8 hours of the day starts and does not finish unless the same period passes. The time of this heat conduction is not at the same hour of the day in all seasons in the year. The major difference is in the heat transfer time period in the summer and in the winter. To particular, since the days are longer in the summer, 7 hours from the sunrise is about the midday, while the end of the same period of conduction in winter is about 3 hours to sunset. Therefore, it is essential to use some techniques to keep the inside temperature in cool rates during summer. Conversely, it is very important to prevent the heat to go out during the knights in snow season. Exploring the other part in the morphological analysis in bazaar will make it clear how to achieve these goals.

2.2. Roofing system and structure analysis in Tabriz bazaar

Domes in different sizes are the most important structural-architectural elements in roofing system of the bazaar. The structures of these domes are totally made by bricks with different types of arrangements. This system made two major benefits for the complex; firstly, it increased the surface and area of the roof as much as it is possible to get the maximum energy from the sun and in the second place, domes made it easier and more economical to repair and maintenance the roof during the time of operation. The thickest parts of the domes are where they join to the piles or...
the thick brick or stone walls in the ending points of their arcs and predictably, the thinnest part is the top bit, which has the highest height in the section. The finish in the internal face is the cleaned and polished brick with ornamental details called “Mogharnas and Karbandi”, while in the external side the finish is mostly a plaster of clay and straw (Kah Gel in local). Although this roofing system provides natural down lights in Rasteh paths and the covered Saras and Timchehs, however, the main important morphological role of the dome roof system in the bazaar is to control the natural air conditioning in the interior spaces.

(Figures 6 and 7 show typical roof details for one of the famous parts of the bazaar called Mozaffarieh, the carpet maker and seller-trading centre. As it is clear, dome roof presents artistic brick ornaments that are shown in reflected ceiling plan (R.C.P.) details. Indeed, as is shown in section A-A, it is acting as an air conditioner valve in the hot...
season for the building. The principle is very simple and it uses the thermal rule that despite cold atmosphere, which is heavy and stays down, the hot weather is lighter and goes up in the air. This fact makes natural air circulation.

As explanatory, sun makes the roof layout heater and it reacts as a thermal mass namely has been described in divider's analysis in the paper. Nevertheless, it is impossible to anticipate one structural system without any program to act different in two different conditions which need dissimilar provisions. For instance, in the summer it is very important to keep the interior temperature cool and not to let the warm or hot weather to stay in, while diametrically opposed, in the winter it is imperative to keep the internal heat in high level and not to let it go out. Water wells on ground and the small openings in the domes are used as natural succours in the emblematic architecture in order to keep the air temperature in the comfort level or close, reducing the expenditures in the consumption of electrical or other kinds of energy for cooling and heating of the urban space. Details of the natural ventilation process in summer and winter come in the following paragraphs;

2.2.1 Morphological analysis on natural ventilation in summer in the bazaar of Tabriz

Given the information above, it is more than obvious that the complex is reaping benefits from all thermal mass in dome roof system, thick solid walls and the flooring. Furthermore, natural resources like water wells in bazaar are very important controlling the quality of desirable air in the interior spaces. In the hot days of summer, when the temperature raises to inconvenient levels, based on the thermal rules, hot atmosphere starts to go up underneath the domes inside the bazaar. The concave area of domes makes the warmed air accumulated underneath the roof structure. The hollow surface in domes leads and directs the hot air to the small openings in the top of the cupola. In this part, as is shown in "Section A-A" in Figure 6, the up coming hot weather in the concave dome, pushes the air to go out from the small shutters, which are located either in arch or top of domes. Outgoing air makes a temporary air vacuum inside the bazaar and a breeze above the roof in outside. Accordingly, new hot air comes in by the vacuum from either provided air ducts, which are like a laid mesh in some but not all parts of the floor in bazaar, or normal openings like doors and windows in IE boundaries. In this stage, new hot weather in covered area passes though the wells, which are flowing inside bazaar. Perceptibly, water wells absorb the heat of the air for evaporation. After natural air ventilation, the temperature of cool air rises again by the heat conducted from thick walls and hot weather inside makes the same process and warmed air goes underneath the concaved domes again. Therefore, the inappropriate hot breeze can change to a desirable air in an extensive urban space, totally naturally, as it runs in everywhere as a typical designed detail. Although this awesome morphological urban strategy used to work properly in the past, unfortunately, by some careless urban amendments some of the wells and their air tunnels in this complex have been demolished. However, with a scrutinized urban planning all these natural elements are recoverable.

2.2.2 Morphological analysis on natural ventilation in winter in the bazaar of Tabriz

Air conditioning control system in winter is the same as described in summer, unless in cold season the residents and merchants in bazaar close all the shutters in domes manually and prevent the heat to go out. Indeed, as discussed in the exploration of thermal mass reaction, since the conduction of the heat absorbed from the sun to the interior space takes place in the late hours of the morning, some of the traders in winter prefer to start their daily commercial activities later than they normally do in the other seasons.

3. RECOMMENDATION FOR CONTEMPORARY ARCHITECTURE

Learning lessons from the past is always helpful to find possible solutions for contemporary problems. We are living in the first decade of 21st century, a time, when we have received many attainments from the previous age and economy has a great influence in almost all sciences. In a comparison of livings of 30 years ago, it is understood that the quality of modern life had changed considerably into economical side (Pacione 2003). The use of energy is playing a major role in the economy of the nations and most of the unnecessary energy consumption, takes place in the active spaces such as residential or office buildings and shopping centres. It might be very helpful if the solutions, which have been provided previously for these issues, come in to the consideration of the architects and urban planners.

To particular, Tabriz market, as an active large and old covered bazaar in Iran, is still getting advantage of the accurate scrutiny that its architects used in their designs. As described in the paper, with the use of natural resources of energy (e.g. water wells, wind and sun power) and some techniques in dividers and roofs, the architects of this 300 years old market were able to produce natural ventilation without using the electricity power for the market. Although this was a great achievement however, it does not necessarily mean that whatever the architects had done in the past is perfect. Obviously, passing the time quality of life has become better for people of the planet. Indeed, many details have changed to better during time. For instance, instead of thick dividers, which wasted lots of energy to be built and maintained, thin and even curtain walls are replaced in the contemporary shopping centre designs. Moreover, Technology is in charge of solving the problems, which architects have been struggling to find a solution for in a sustainable urban space. For example, "Photovoltaic panels" are the result of using nano-technology in

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material industry, which is to make the dreams through, to make so many advantages achievable (Nalwa 2000) saving lots of energy.

In the review of Tabriz bazaar, some relations between the typology and morphology of the urban space look unique. Although, there are various commercial functions in the complex, however, the morphological definition for the urban space is typical and sustainable in almost everywhere. The reason might be that the urban morphology of the aggregation, including the pack of urban elements and structures, is highly trying to use natural resources in operation time. Therefore, the most important recommendation in design of shopping centres can be to get maximum natural resources to control operational requirements.

CONCLUSION

This study investigated the use of natural resources in Tabriz traditional bazaar in Islamic Republic of Iran. As sustainability can be easily claimed in buildings that have been alive for centuries (Maver and Petric 2003), Tabriz bazaar can be a delegate as an active sustainable urban space, having served for more than 3 centuries.

Tabriz bazaar is a good pattern for a defined urban space as all city elements of Kevin Lynch can be recognised there. It is multi-functional in use, and the accurate detailed design in districts allows all functions including social behaviours to accept each other and form a unique complex, which benefits from natural resources in its life span. Paths, nodes, landmarks, edges and districts are very well designed and have such a good regularity that makes it very clear for visitors to read the urban space and locate themselves in the planning. Variation in urban typologies and land uses makes plenty of districts separated by paths, which end to landmarks like open courtyards. Edges, floorings and the roofs are made of local masonries such as stones and bricks. Nodes are the intersections between paths and almost all of them are higher than the corridors and pathways to put emphasis in district changes.

These urban elements help to make links between urban forms and urban functions. However, reciprocal links between the forms and the functions in bazaar would not be created unless a good urban morphology was set. Providing ventilation using the natural resources, and the ease of maintenance with local materials are probably the two great morphological outcomes that have given the market a long time of effective commercial footprints in the environmental, social and economical backgrounds.

To sum up, lessons from the past might be very helpful considering contemporary issues particularly problems dealing with energy consumption. Although the look of old patterns do not seem very logic with the contemporary architectural methods, however, getting the overall ideas from the past and putting technology into it, can make the current issues amended and accordingly lead to a safer future for the next generations of human being.

REFERENCES


