New added values to the existing Chinese heritage shop-houses' courtyards towards occupant environment wellness: a case study at Kota Bharu, Kelantan, Malaysia

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Abstract. A courtyard is a main architectural component commonly found in the Chinese traditional shop houses, which was introduced by the Chinese traders. Although many studies have been done previously regarding the courtyard design, not many types of research have been done on the community buildings on the east coast of Peninsular Malaysia, especially in Kota Bharu, Kelantan. Moreover, not much information to be found towards suitable methods on the courtyards' elements modification and its impacts. Hence the purpose of this study was to examine and discuss new added values towards these heritage shop houses courtyards components alteration within the city of Kota Bharu, Kelantan, Malaysia, without changing its purpose and benefits. The research employed a qualitative method through visual observation and in-depth interviews within its building occupants as well as experts to seek their perceptions. The early findings demonstrated the courtyards had their own uniqueness in cultural aesthetics and functions. By adding certain new values such as glass roof windows, planting, water elements, and modern materials, it can provide better internal environment satisfaction to its building and occupants. However, these added values must be well planned and controlled so that they do not harm the heritage values.

1. Introduction
The Chinese heritage shop-houses building commonly consisted of two floors of narrow and long dimensions. It is not only provided as residential areas but also as a business and a religious space with an expression of their cultured symbols and elegant lifestyle [1, 2, 3, 4, 5]. As the building is characterized by deep long, and compact, it lacks of lighting and air ventilation, thus the usage of courtyards provides the necessary conveniences for the occupant wellbeing. The inner space environment air ventilation and lighting could be improved by the openings of air-well in the center of the building [6].

Even though many studies have been covered on these building architectural components, but only few were done within the east coast of Peninsular Malaysia context especially in the city of Kota Bharu, Kelantan. Furthermore, with not much information regarding proper added values on the courtyard elements alteration within the buildings in the city, makes the owner did incorrect decision such as covered the whole opening area with permanent traditional methods such as metal awning and canvas. This causes the area lack of lights and of air ventilation as well as less aesthetically.
Therefore, this study would like to seek suitable new insight on the Chinese heritage shophouses courtyards elements modification within the city of Kota Bharu, Kelantan towards its buildings and occupant wellbeing in today's living without harming its purpose also architecture beauty.

1.1 The Chinese Heritage Shop-Houses' In Kota Bharu, Kelantan.
The east coast of Peninsular Malaysia, such as Kelantan had been visited by many mainland's Chinese traders and sailors for centuries, including a group movement from Thailand (Siam)- Chinese, which led the interaction among them and the local communities. It was believed to happen sometime before the 1800s [7]. Over the years, the Chinese residents of Kota Bharu had developed a unique identity as a result of adapting many aspects of the local lifestyles through long interactions, including the hybrid form of architecture and these including the unique styles of shop-houses, which consists of commercial area on the ground floors and dwelling spaces on the upper floors as well as openings courtyards. In fact, many of the buildings designs were influenced by the traditional architecture of the mainland China where they were originally came from one of the provinces of China [1, 2, 5, 8].

Today Kota Bharu, Kelantan is still having approximately 50 to 80 of these community heritage shop houses with more than 150 years old of buildings. However, many of these architectural buildings are facing uncontrol alterations especially the courtyards elements by the new generation without knowing and aware of its impact towards the occupants and heritage values.

Therefore, it is important to provide the information needed to the shop-houses owners and local authorities regarding the importance of preservation and proper ways to modify them.

2. The Courtyard Benefits
In general, a courtyard which also known as 'air-well' or 'sky-well' is a full opening to the sky located inside the shop houses and its function is as a microclimate control to provide natural air ventilation and lighting to the building and its occupants [6, 9, 10, 11]. Even though the basic plan or shape of a courtyard is commonly rectangular or square with a sunken floor, it also depends on the house topography, building orientation as well its functions.

As the shop-houses building is characterized by deep long and compact, it lacks of lighting and air ventilation. Thus the usage of courtyards provides the necessary conveniences. The inner space environment air ventilation and lighting could be improved by the air-well through stack effect which generates a wind flow and allow the sunray to penetrate into the space. Furthermore lacking of good air ventilation and insufficient lightings would make those space areas became damp, stuffy, and humid, which then make unpleasantness, uncomfortable and unhealthy life to the occupants' wellbeing [10, 12, 13].

Hence, to finds proper solutions to alter these architectural elements; courtyard design without destroying its purpose and heritage values is vital.

2.1 Indoor Occupants Environment Quality
Building occupants comfort responded to an indoor environment in the architectural perspective includes mainly air ventilation; thermal comfort, and adequacy light [2, 5, 6, 14]. Thermal comfort in the building is a condition that expresses satisfaction with the surrounding environment. Factors influencing include air temperature, air velocity, and humidity. Meanwhile, lighting is a process, a way the act provides light. Light is vital for human vision, especially in recognizing the environment and run activities [2, 14].

It is important to provide good air ventilation and the lighting environment in buildings as it affects the occupant's health and daily activities performance.

Thus, it also vital to create a conducive space for the occupant wellness within the traditional shophouses building. To seeks a proper alternative way to modify the courtyard elements is a major concern.
2.2 Traditional Method On Courtyard Covering

According to past research, there were two types of buildings courtyards topology covering widely used, one was the partially covered which allow certain amount of natural lighting and air ventilation into the space, meanwhile the other was fully covered which totally block [6, 9].

Among the most used materials found to be applied as covering were the traditional metal awning, which completely blocks the natural sunray and air ventilation into the space below. Meanwhile, materials such as canvas and polycarbonate are either colored or cleared however allow certain of amount of natural lights to be penetrated while blocking the natural air ventilation. Netting nevertheless allows certain amount of both natural lighting and air ventilation [6, 9].

However, all of these materials give low aesthetically towards the overall building courtyards environment. Provide new insight added values on the building courtyard elements modification without affecting its existing heritage building architectural splendors and its environment occupants wellness were the focus.

2.3 Theory Framework

The framework (Figure 1) is to serve as a foundation for this research. Based on the gathered information above, this framework will be focusing on the relationship of the suitable new added values towards the existing Chinese heritage shop-houses' courtyards elements alteration and its indoor environment occupant wellness.

![Figure 1](image.png)

**Figure 1.** Adapts framework of relations between the new added values on the Chinese heritage shop-houses courtyard elements changes and its impact within indoor environment status as well as its occupant wellbeing.

3. Methodology

This paper applied a qualitative research method which employed visual observation and in-depth interview within the Chinese heritage shophouses courtyard in the city of Kota Bharu, Kelantan and its occupants as well as experts. The information was also gathered through secondary data. Not many researchers have carried-out investigation on the new add values towards the existing Chinese heritage shophouses courtyards elements modification and its impact. Changes in lifestyles and business operating have resulted in most of these buildings courtyards elements faced alteration. However, it's important to be properly done without changing the courtyard's purpose and benefits. Lack of information on proper added value towards the courtyards by the owner are among the main reason these brutal changes happened. Therefore, to find a suitable way to altered these architectural elements; courtyard design without destroying its purpose and heritage values is very important.

An observation checked the list and set of structured Likert scale questionnaires were specifically designed for the study. Finally, a table containing major types of related themes such as suitable new
added value within the courtyard components changes, its impact on indoor environmental conditions, as well as its occupant's well-beings perception was produced.

4. Findings and Discussion

4.1 Observation

Based on the observation carried out, about 50 to 80 Chinese heritage shophouses were found within the city of Kota Bharu, Kelantan. The building was originally built in the late of the colonial influences between 1927 to 1950s in a moderate style.

There were problems encountered during the data collection. Researcher cannot gain access into the building in order to observed the building courtyards elements and the quality of its indoor environment as well to gain in-depth interview with its occupants due majority of the shop houses owner were refused as its operated private business. However, the researcher managed to gain access and had close observation on a total of 20 Chinese heritage shop houses and its courtyards design as well recorded its occupants perception within the city of Kota Bahru area.

4.1.1 Current State Of The Courtyard Elements Alteration

Based on the closely observed within the 20 buildings, a total of 16 of the Chinese heritage shop houses have done major alteration within its courtyards elements which they covered, meanwhile four remained originally open. From the total of 16 covered courtyards; 12 were totally closed while four were partially closed. Furthermore, from the 12 totally fully closed courtyards total of 10 were enclosed the opening by extends the floor and roof above to gain more useable spaces and two were only at the roof sections. Among the reason to enclosed these openings were due to roof water leaking and rain water scattered.

There were four main materials noticed to be used to covered the courtyard area which are roof tiles, metal awnings, polycarbonate, and netting. Materials such as roof tiles and metal awnings totally block the sunray into space, which causes a lack of natural light and air ventilation into the space, meanwhile, polycarbonate allows a certain amount of light to be passed but not the air ventilation. Netting on the other hand allows both. However, these types of covered courtyard materials give less aesthetically towards the overall environment of the space. Finding for new methods and materials which can be blended within the courtyard elements is needed.

The courtyard with fully covered either extended floor or used materials such as roof tiles, metal awning, and polycarbonate, the indoor environment areas feel gloomy - dark, poor lit, hot and less air ventilated. These cause by the new alteration has interrupted the existing functions of the opening. Many artificial light and mechanical air ventilation were used to provide the needs convenience. For the partially closed courtyard, the areas were often dark in certain period of time even materials used such as roof tiles, metal awning, netting and polycarbonate. However, these added elements did not interrupt the air flow within the space. Fully open courtyard provides the best natural air ventilation and lights into the space.

4.1.2 Added Values Within The Courtyard Elements

The additional added values found within the courtyards elements were in most of the fully and partially opening courtyard. Certain of the area was decorated with a variety of greenery plants which planted in decorated planter box and arranged nicely either vertically or horizontally. Noticed also in certain of the space allocate the water elements such as pond and small fountain at the center of the courtyard.

These added values such as green wall and pond provide better cooling air movements and lighting distributions with the space. Furthermore, it enhances the overall aesthetics of the environment space.

4.2 Interview- Impact on Building Occupants Wellness

From the interview conducted, a total of 22 occupants' respondents were documented based from the closely observed above from various locations and types of Chinese heritage shophouses within the city of Kota Bharu, Kelantan. According to the result, a total of 14 respondents were documented within the
A completely enclosed courtyard, meanwhile, eight were from fully and partially open courtyard. Table 1 shows the perception of the results towards respondent's indoor environment quality comfort in the building.

Based on the results obtained, majority of the respondents were male with score of 18 follow by female. The aged group recorded most respondents were young working people with score of 16 follow by teenagers and senior citizen. Among the daily activities by the respondents include working, studying and resting. For required aid, most of the respondents needs eye glasses for certain periods.

According to the data, majority of the respondents within the fully enclosed courtyards were unsatisfied towards its current indoor environment quality with score of 13. Lack of lights and air ventilation were among the reasons with score of 15 and 16. This due the used of materials and fully alteration within its courtyards which interrupt its functions and benefits. The respondents state that they need to use other resources to enhance the indoor environment convenience such as artificial lighting and mechanical air ventilation (fan and air-conditioning) with score of 17 and 19. Overall the feeling towards the building environment showed that the respondents felt depressed which contributed towards their low daily activities performance. Furthermore, total of 14 respondents from the full covered courtyard stated that there were none additional added value were allocate within the space which can enhance the indoor environment quality and their wellness.

For the fully and partially open courtyard, the respondents were satisfied regarding its current indoor environment state with score of 9. This supported by the good lighting and air ventilation within its space with score of 7 and 6. Even though, part of the building courtyard has been covered, it's still allows certain amount of lights and air movement within the area. Thus, provide conducive indoor environment quality. They also stated that the building does not required much of artificial lighting and mechanical air ventilation within its buildings with score of 5 and 3. Overall, these conditions have contributed to the respondents feeling of pleasantness which affected on their high daily activities outcome. Moreover, 8 of the respondents stated that part of the courtyard were decorated with additional added values such as greenery plants and water elements which improve the indoor environment conditions and their wellness as well as provide good aesthetics into the space. These added values distribute more lighting and allows more air movement within the space thus cooling as well as brighten the area.

Even though the information gathered from the respondents seems to be varied in their point of view from one to another, it could be seen that the overall indoor environment pleasantness of the building was positively affected by the open courtyards elements. Additional added values such as greenery planting and water elements also contributed towards improving the ambiance.

By closing all the opening courtyards and using unproper materials, the inner space areas of natural air ventilation and lighting became block and interfering with the airflow which contributes towards air temperature and humidity, and also natural light which was important towards its occupant's wellbeing. Therefore, looking for new methods and materials that suitable within the courtyard elements alteration was important.

After all, the majority of the owners were unaware regarding the added values towards the courtyard's elements alteration, and it's proper building materials, including the occupants' wellness.

**Table 1.** Occupants respondent's response on current state Chine heritage shophouses courtyards elements alteration towards indoor environment quality.

| Types of Chinese heritage shop houses courtyard alteration topology | Fully covered courtyard | Partially covered courtyard | Fully original open courtyard |
|---|---|---|---|
| | 12 | 4 | 4 |
| Types of Chinese heritage shop houses courtyard alteration covering building materials | Fully covered courtyard | Partially covered courtyard | Fully original open courtyard |
|---|---|---|---|
| Fully block materials | 16 | 2 | 2 |
| Partially block materials | | | |
| Unblock materials | | | |

| Respondent sex | Male | Female |
|---|---|---|
| Respondent aged group | Below 21 years old | Above 21 years old | 60 and above |
| Respondent daily activities | Studying | Working | Resting |
| Does required wearing glasses? | Never | Sometimes | Always |
| Respondent satisfied on the current state of the building indoor environment quality | Very Unsatisfied | Unsatisfied | Satisfied | Very satisfied |
| Respondent satisfied on natural lighting within the building space | Never | Rarely | Most of the time | Always |
| Respondent satisfied on natural air ventilation within the space | None | Little | Some | Substantial |
| Do you feel depress within the building space? | Very unimportant | Unimportant | Important | Very important |
| Does the building usually use its artificial lighting? | Very unimportant | Unimportant | Important | Very important |
| Does the building usually use its mechanical air ventilation? (fan or air-conditioning) | Very unimportant | Unimportant | Important | Very important |
| Does the building indoor environment contribute towards your daily activity performance? | Very unimportant | Unimportant | Important | Very important |
| Does the building have any sick building syndrome symptoms? | Very unimportant | Unimportant | Important | Very important |
| Does there's others added values within the courtyard elements | Very unimportant | Unimportant | Important | Very important |
| Does the added values contribute improving the indoor environment | Very unimportant | Unimportant | Important | Very important |
| Does the added values contribute improving the occupants wellness | Very unimportant | Unimportant | Important | Very important |
Does the courtyard important towards the building comfort?

|                | Fully covered courtyard | Partially covered courtyard | Fully original open courtyard |
|----------------|-------------------------|----------------------------|-----------------------------|
| Does its important to maintained the courtyard? | 0 | 5 | 11 |

4.3 Proposed New Insight Added Value Towards The Courtyards Elements Alteration

From the interviews with the experts, a total of three respondents were managed to be interviewed and their opinion was documented. They had given many new suggestions in order to preserve, alter and improve the existing courtyards elements.

Among them were the uses of mechanical roof window glass system, which allow controlling the amount of sunlight and natural ventilation such as air temperature, airflow and humidity into the building remotely. The traditional internal awning often causes lack of lighting within the inner space which contribute to the usage of artificial lighting. These external mechanical roof window glass system presents a simple solution and have been utilized for many years but technology have made it more versatile and appealing, allowing to be integrated into the building envelope.

Other simple methods were the sliding skylights and mechanical retractable awning. These systems are available in manual or mechanical operation, which switches or remote control to suite occupant. The sliding and retractable allowing the panel to open, allowing breezy to flow from outside into the inside. Furthermore, the system provides protection below of the courtyard from raining, which allow the occupants to have activities throughout the year.

Shading is a simple method to block the sun from entering the building. However, new improvements of materials and design such as numerous blade shapes, blade spacing and angle, and trim profiles allow a design selection to create diffuse light. Thus, the directed sunlight is becoming scattered light.

The natural elements within the courtyard itself were also found to increase the comfort condition of the courtyards. Shrubs, trees, flowering plants, and grasses, which were used to shade areas, can be potential elements to control the environment. This is supported by a previous study done by Zango, (2017) [15]. Vertical greeneries were also an excellent choice to cool down the microclimate within the inner space, which tends to be modified and expanded vertically.

Furthermore, the use of water bodies such as a pool, pond, or water spray was found to cool down the air temperature in the internal courtyard and its surrounding areas effectively.

5. Conclusions

In this study, the important role of the Chinese traditional shop houses courtyards elements towards its building and occupant's wellbeing by controlling the natural lighting and air ventilation of the inner space was done. Through the study shows that by completely closed or covered the courtyards elements with unproper methods as well as materials, many problems have emerged, including discomfortness, unpleasantness, and unhealthy livings. These were due to the insufficient supply in air flow, air temperature, humidity, and poor illuminance. Therefore, the findings obtained from this study highlighted the alternative ways to added values regarding the alteration of the courtyards elements within the Chinese heritage shop-houses. Also, the additional values which influence improving the indoor environment as well as occupants wellness. Some design strategies were discussed in terms of controlling the microclimate, such as roof windows glass system, sliding skylight panel, mechanical retractable awning, shading, the use of greeneries, and water body. This study recommends further studies to analyze the strategies extensively by simulating them with analysis software.
**Recommendations**

It is suggested that the Chinese heritage shop houses owners need to re-open and reuse proper methods and materials covering on its courtyards elements alteration without harming its purpose and benefits. Besides only looking about owns interests, they need to consider the building environment’s condition as well as its occupants wellness. Implement suitable added values within the courtyard elements space can improving the overall indoor environment quality, which also contributes to the occupants’ wellness and work performance.

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