Flexibility design idea in functional space Arrangements of Hajj transit camp Buildings in Nigeria

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Abstract— Flexibility in designing functional spaces that could be multifunctional to serve for various activities and events is an important concept especially in the design of transit Hajj camp Buildings. This allow for more usability of the functional spaces, thus accommodating change over time rather than periodic used of the functional space in the facilities which is only during the hajj operational exercise. This has led to the underutilization of the Buildings. As such the concept of flexibility refers to the idea of accommodating change over time, and concern with technical weakness of those spaces which are form rigid meaning are inflexible that cannot be used for other purposes. This paper observes and evaluates using descriptive study on the cased transit Hajj camp Building serve as a gathering place for a particular period of the year, so it needs to be adapted to changes to its undefined user. A framework for evaluating various characteristics of flexibility was used. Hence the data collected were analyzed and discussed. The finding of the study indicates some factors such as nested space, selective connectivity and disconnectivity multiple entrances for each space useful for contemporary Architecture and are good for .changing conditions.

Keywords: Flexibility, Adaptability, Multifunctional, Design, Spaces.

1 INTRODUCTION

The concept of flexibility is vital in the design. Flexibility refers to the idea of accommodating change over time. Thus, flexible building corresponds to "a building that can adapt to the changing needs of users" [1]. Fixed arrangements imply boundaries and inhibit spontaneous adaptations to new forms. Studies has shown that the concept of flexibility is not a new topic, in spite of that, it has been considered as a basic principle in traditional architecture of many countries such as Japan, Turkey and Iran[2]. Beside all the benefits flexibility can bring with itself, existence of that seems more critical by the times changing functions is required [2]. For example in Nigeria, we have Buildings with multi-functional characteristics like the transit Hajj camp which has both religious and other correspondence activities; it means they require adapting to various functions in different days of the year. A flexible structure has a built-in capacity to adapt in a predefined way. Flexibility can be everything from automated sun screening to a clever layout in dwellings to expand or diminish according to changing needs. Adaptability and flexibility have been addressed in a number of ways over the years [3].

According to the Dutch architect and researcher Bernard Leupen there are principally three ways for a building to deal with uncertainty and time. The first one is to make buildings polyvalent. With polyvalence Leupen refers to the quality of a space that can adapt to different functions without needing to make a change. The term derives from the French *salle polyvalente* [3]. In this research, we analyze solutions of these Buildings toward meeting changing needs and demands in the special framework which has been derived from the theoretical background.

2.0 FLEXIBLE ARCHITECTURE

There are various definitions of flexibility from different authors who have focused on this field of architecture, also there are some dissidence and discussion about differences of "flexibility" and "adaptability", but considered the term "flexibility" as an inclusive concept that covers adaptability as well. "Flexibility is the aptest term for designating at abstract level the property of dwellings and residential buildings which can be adapted to the dynamic process of habitation". "Flexible architecture consists of buildings that are designed to respond easily to change throughout their lifetime". "Flexible buildings are intended to respond to the changing situations in their use, operation or location." "A broad definition of flexible building is building that can adjust to changing needs and patterns, both social and technological [2].

These changing needs may be personal, practical, or technological (i.e. it includes the potential to make changes prior to occupation as well as the ability to adjust one's housing over time after occupation". However, a consensus on the essence of flexibility is clearly revealed, which can be defined as: the pre-arranged response to change, the change can be pre-occupancy (according to the users' personal preferences).

Classifications of flexibility

Beside various definitions, many authors categorize flexibility in different forms to clarify the conceptual framework of the study better; some of the classifications will be investigated.

The first classification is for Dittert (1982), [4]. Which is quoted in [5]? He classified flexibility into two groups: Functional flexibility and structural flexibility.

In 1990, Van Eldonk & Fassbinder [6].Added one group to the Ditterets categorization, which was "Character flexibility". So the outcome of this categorization became as below:

'' **(a**)'' Spatial (structural) flexibility: This flexibility is not only related to structural changes but also to the physical alteration occurring in the interior space. Dwellers can change their houses according to their own preferences based on professional intervention [2].

'' **(b**)'' Functional flexibility: the ability to change the condition without professional intervention. It is based on assigning new functions in redundant rooms, changing the room function or the relation between the rooms [2]. .

''**(c**)'' Character flexibility: possibility of changing the façade or dwelling identity aspects of architectural quality. It is aimed to clarify this classification. More, many authors tried to determine some notions for each category. According to Al-Dakheel (2004), [7].and Gulaydin (2004) [8].quoted in Bakkalolu (2006), [9].added more detail to each category.In the works of Hofland (2005), [5]. There are different types of flexibility. These are:

1. Neutral for furnishing, (functional).

2. Possibility for change of floor plan, (structural).

3. Possibility to reshape apartments, (structural).

4. Modernization flexibility, (structural and functional).

5. Character flexibility (identity), (cultural).

6. Flexibility for changing safety requirements, (functional).

7. Wheel chair adaptability, (functional).

8. Capacity for expansion, (functional).

9. Multi functionality, (functional).

10. Parking flexibility, (functional), [5]. (Hofland, 2005).

Flexible Architecture

The objective of flexibility in the architecture is to provide spaces with simply changing Structures in respect to changes in required performance and application. Though Architectural spaces could be identified and restricted through physical elements such as Floor, ceiling, and walls and so on, it should be designed in a way that changes flexibly [10].

Flexibility in Vertical Partitions

The (Figure 1) below indicate some designed of vertical partitions that are movable and are used in reshaping space for aesthetic, Functional and economical uses in the same time in order to make best and maximum use of plot area that responds to people needs[11].

Figure1: vertical-rising movable wall, source; http://www.buildingdesignindex.co.uk [12]. (2016).

Flexibility in Horizontal Planes and Levels

Flexibility in horizontal planes and levels is used for getting appropriate interior spaces that responds to people demands, so that it makes it possible to control space levels and the economic efficiency that reached from responding multiple needs in the same space, as it reduces demanded plot area.

The use of vertical partitions, horizontal planes levels flexibilities together to change the vertical partition to horizontal one and to reach maximum flexibility at minimum space. Using this building material technology and architecture, it would respond to various conditions by changing the relation to large and some relates functional spaces [11].

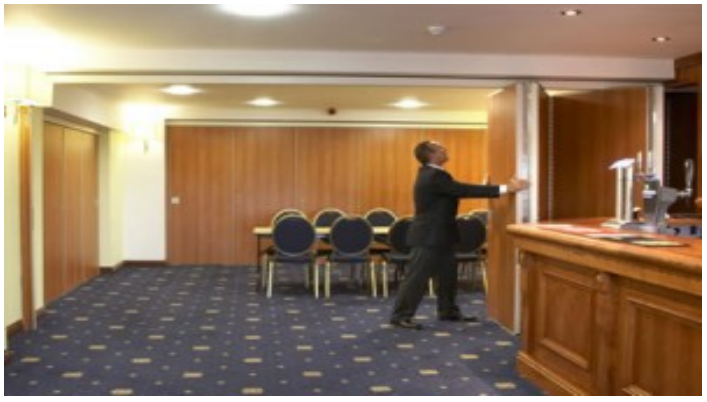

Figure2: wooden folded patitionable system, source:www.buildingaddittion.co.uk multifold, [12]. (2016).

Flexibility in Furniture

Flexibility in furniture is to describe furniture as a physical property of furniture itself, that chair can be converted to a bed or table etc. However, there is another design idea that depends on the relationship between furniture and space so that (as an example) the bed can be hidden into a wall or ground, or raises it to the ceiling to be part of design. The furniture can have some shape properties that add another type of flexibility which gained from repeating the furniture piece with changing the arrangement or adding other pieces without decreasing the aesthetic and functional efficiency of space the (Figure 3) below is one of the types of flexible furniture design use for functional efficiency of space [10].

Figure 3: Flexibility in furniture design. Source: [10]. (2011)

ADAPTABILITY

Adaptability in architecture is defined as an ability to recognize that the future is not finite, and that change is inevitable, but a framework is an important element in allowing Change to happen." Adaptable buildings are designed to adjust to the different functions, defined by users' activities [12]. Adaptable architecture also makes room for all the technological innovations that can improve the previous installations of the building. Such flexible updating in communication, security and other service systems allow changing layouts and functional specifications of the Building [12]. At the same time the technological advancement allow for the creation of self-optimizing buildings, rather than merely best-fit compromises. Adaptability in architecture is also recognized as an essential component in creating sustainable architecture,

Preserving and adaptive reuse of a building instead of demolishing it and erecting new one in its place contributes significantly to the environmental sustainability [13].

An adaptable building can adapt new functions, and an adaptable city can regenerate and accelerate to adjust to fast development and thus be revitalized in uses and functions. Adaptability works within the concept of relative space that focuses on process. Flexibility is the third concept of how to deal with change. A flexible structure has a built-in capacity to adapt in a predefined way. Flexibility can be everything from automated sun screening to a clever layout in users to expand or diminish according to changing needs [13].

MULTIFUNCTIONAL SPACE

A multifunctional space performs at least two functions. According to Longman dictionary a multifunction space is designed to have several different uses. Oxford dictionary, Com/definition/multifunctionalS(2011),[14].

Multi-functionality is the ability of having different functions at a time, at the same place or by same furniture [2].

Multifunctional Spaces are the opposite of single-purpose space which is designated for a specific function .In the literature of architecture, a space that accommodates several activities is a multifunctional space. According to this definition, courtyards and kitchens are multifunctional spaces Bemanian, (2012).Also multifunctional spaces can be transition spaces. But from another view, they are the spaces which are used for exhibitions, lectures, and special events [2].According to [2]. (2016).Multi-functional space can be described as a true integration of different functions in time and space [15].

This is different from mixed-use development that compartmentalizes the various uses within a community or a landscape. However, implementing multi-functionality within communities creates spaces that have multiple purposes. Due to their access to diverse uses in one place, these spaces can contribute to a community's vitality [15].

The other noticeable potential is the role of multi-functional concept in the design of the spaces. It's being so, Variability in dimensions, situation and shape but in concern with special modularity "multifunction space" provides the ability to use the spaces in different ways it depend on the spatiotemporal characteristics of the operations and functionality of the building. By definition, any space can be used in different ways for several purposes in predefined period of time or even for different functions in a certain time as well [2].

SPACE FOR MULTIFUNCTION

Space is a site for human interaction, dealings, rituals, games and spectacles. These actions determine the spatial design to a great extent and the spatial features influence the user and the functions. People focus on the functions of the target space now. Building and design of a space considers the relationship between space and functions. Design with functions is a key

point to transform a space to be brand new place. The parameters of spatial designs are important elements [16].

The function always affects the final spatial form. Spatial types can be identified and distinguished by how clearly its specific function can be recognized in the structural design. Specific architectural requirements and the purpose can strongly influence a spatial design and the functions.

Bruno, Zevi briefed "All the techniques of representation and all the paths to architecture which do not include direct experience are pedagogically fruitful; but their function is no more than allusive and preparatory to that moment in which we, with everything in us enter and experience the spaces we have been studying [16].

The important of function in a space, aside of function and use, possesses other distinctive features that are significant to spatial design and can be emphasized as specific spatial qualities. Space is perceived physically by all the feelings and cognitively with mind. Every site has its own specific, spatial environment, linking the design of building changes the form of its surrounding space that determines a structure's possible design options. Multifunction helps in a different way such as technology, design and opens another page of quality of life.

Functionalism principle in architecture as an area is focused on the benefits from the design of structure, material and systemic usage [16].

However, Multi-functionality is offered in the sense that offices can be changed into apartments and vice versa (During the development process, the designed flexibility already proofed to be worthwhile: demand for offices was severely decreasing, so partly a switch was made from offices to apartments [17].

Multi-functionality is formed by the access systems: every single floor is accessible separately. More so, employees can have access to their offices and residents to their apartments using "free" entrances. All structures and fittings are arranged in a way that they meet the most severe requirements from both residential and commercial purposes. In spite of the technical provisions, however the possibilities to change the size of the apartments by relocation of floor space are limited [17].

HOW THE SPACE AFFECTS FUNCTION

People always take place within a space in their daily life; this is the reason people design the spatial environment according to their needs, whether a landscape, a city, a house, a room [16].Space which is not looked at through a keyhole, not through an open door, space does not exist for the eye only; one wants to live in it. The purpose of a space is the main consideration for designers before they start the plan. It is a complicated factor which affects the final layout of the space. A site is influenced by many complex and diverse factors. There are different architectural contexts and each determines the type of building design. The scale between space and architecture, especially the most standard occurring sizes, is determined primarily by the structural usage, and is always perceived in relation to human scale and the adjacent spaces. People are affected by the relative perception of spatial scale effects. Architects and planners have developed some systems over the course of the architectural history, all which refer to human scale; one of the most recent is Le Corbusier's "Modulor" [16].

3.0 Methodology

Qualitative research approach were adopted for this study using case study as the strategy , and primary data collection involves using physical observations method, with evaluation checklist for assessment as instrument for data collection, supported with sketches and photographs.

4.0 Case study: Kano transit hajj camp

The Kano zonal transit Hajj camp started operation in 1976 after the enactment of the Nigerian Pilgrims Boards, an act of 1975 with the aim of providing temporary accommodation to the intending pilgrim enroute to the holy land (Mekka). The camp is to serve as a venue for pre-hajj and post Hajj activities before the pilgrims' departure and on their arrival from the holy land (Mekka). The building is used only for Hajj operational exercise during the Hajj period; the structure is left out of use immediately after the Hajj operation. Hence this paper discuss how this could Change the usability of the building after the non-Hajj period by observing the concept of flexibility design idea in existing functional space arrangements.

Figure 4: The Kano zonal Hajj transit camp

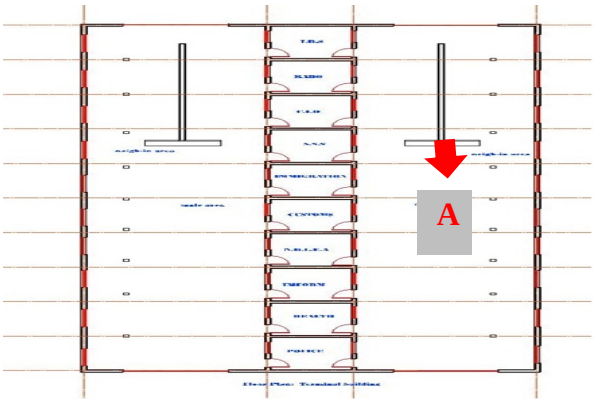

Figure 5: Floor plan of screening hall with good (structural flexibility).

Figure 6: Interior view of functional space arrangements in pilgrims screening hall with good (structural flexibility).

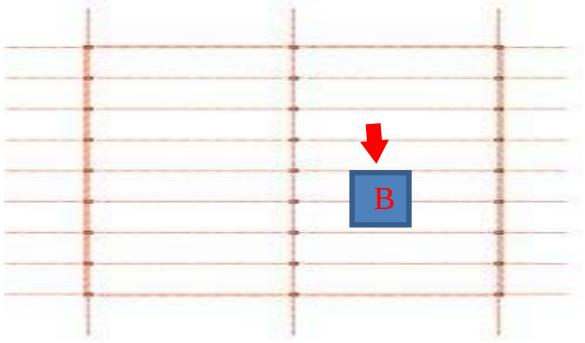

Figure 7: Floor plan of departure hall with good spatial (Structural flexibility)

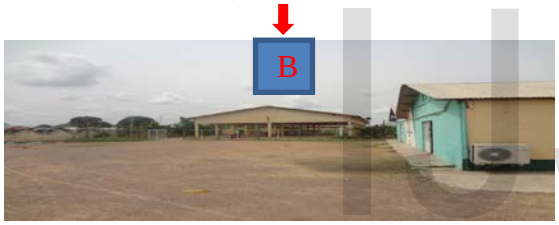

Figure 8: Front elevation of departure hall with good spatial (Structural flexibility)

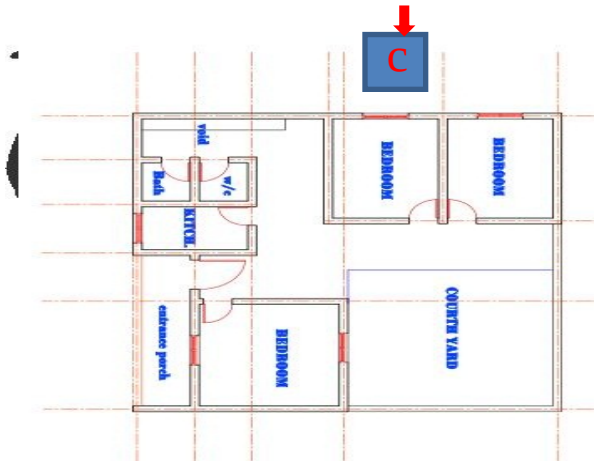

Figure 9: Floor plan of pilgrim's accommodation in Kano transit Hajj camp with good functional space arragenment.

TABLE: 4. 1.CASE STUDY EVALUATION CHECKLIST FOR THE ASSESSMENT OF EXISTING KANO HAJJ CAMP BUILDING.

s/no	Variable	Checklist	Level of application: Very poor, Poor, fairly good, good, very good,					
			1	2	3	4	5	Remarks
1.	**Structural flexibility**	Flexibility for change in purpose			✓			Some facilities can be structurally altered to serve for other purposes.
	Functional space arrangement	Adaptability of the functional spaces				✓		Due to theflexibility in some functional spaces, Hence some spaces can be adaptable to changing needs.
	Spatial flexibility	Convertibility of the functional spaces			✓	✓		If introduce new structural technology it can easily converted.
	Functional flexibility	Multifunctionality of the functional spaces						Some functional spaces can serve as multifunctional spaces due to its flexibility in the design.

Table 4. 2: Summary of results from the case study evaluation assessment.

Variables	Average Score	Remark
Structural flexibility	3	It has the ability.
Functional space Arrangement	4	It can be adaptable.
Spatial flexibility	4	It can be converted.
Functional flexibility	3	It potential for other Activities.

A graph was established using data in table 4.2 above which shown the range of the frequency of scores for each variables in the figure 4.1 below.

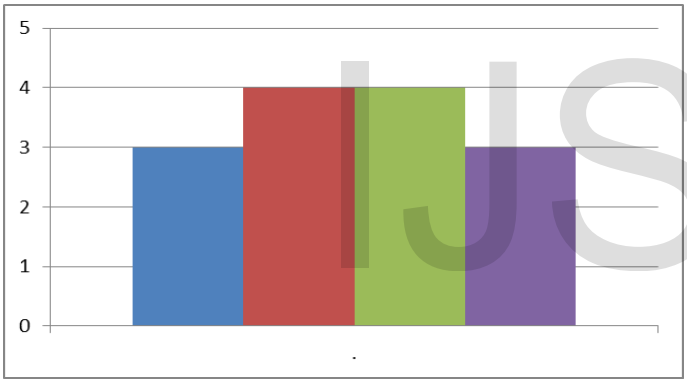

Figure 4.1: Frequency of scores of each variable in Kano transit hajj camp.

It can be seen that level 3 and 4 have been applied simultaneously and is above the criteria limit. It shows that, the cased studies is good which room further analysis of the case studies.The graphs as shown in figure 4.1 the rate of performance of the variables and level of which it has been applied in the transit camp studies.

4.2 Discussion and Analysis

The theoretical frame work spatial/ structural flexibility is more concerned with professional interventions as a way to change the condition by the aim of satisfying different users; it depends on physical and structural features of the building. The change based on size and situation which gradually increase need for more activities and events, to separation into multi-functional spaces. Horizontal, vertical and furniture flexibility arrangements layout are observed due to modularity. In this case, due to existence of lager and regular configuration of spaces, technically it is possible to divide it into different spaces for variety of activities to be performed but in regard to religious issue of dedication. In building scale structural system of the spaces should be considered as like as any other common buildings.

The load and non- bearing walls which has sand screed hollow block, possibility to converting the structure to multifunctional building is restricted and. In spite of impossibility to rearrange the position of walls for making changes, due to the building technology and the architecture, it can still respond to various conditions by changing the relation to large functional spaces can apply flexibility rules. In conjunction with the relevant spaces, all spaces have potential to be combined or separated.

(**a**)The ability to change the condition without professional intervention is the main point in evaluating this functional space arrangement factor. Assigning new functions or changing the former functions or rearranging the relation between spaces is the main target to achieve this so called functional flexibility. Based on these discussions, it has shown that the existing load bearing wall system lack today's technology, structural modification in the hall for spatial multi-use has been limited. Nevertheless, it is possible to observe the large space which is divided into a number of sub-spaces by using some tools such as the sand screed hollow blocks, each of these subspaces could have various functions and they could exchange and convert their functions with each other as well. The spatial arrangement in this transit hajj camp is flexible toward requirements.

There is no obstructed space in this hall. Each space, besides its dependent function, has the potential to combine with other spaces. The ten-door rooms could create a bigger room for gatherings for other activities to be performed, and the offices have the ability to get combined and create a bigger area and show the maximum capacity of the hall for variety of activities.

(**b**)The first is to make buildings polyvalent. With polyvalence (Leupen) refers to the quality of a space that can adapt to different functions without needing to make a change. The term derives from the French *sale polyvalente* [3]. The existing space

is capable to be used to perform different function, it can re-arrange with flexible furniture arrangement layout for changing condition based on users need' users can change the condition of the space without any professional intervention suite their variety of needs. Hence, from the functional floor plan the quality of the functional space can be adaptable and be easily converted to meet for different event, activities, and functions.

(**c**)Multifunction space" provides the ability to use the spaces in different ways is depending on the spatiotemporal characteristics of the operations and functionality of the building. By definition, any space can be used in different ways for several purposes in predefined period of time or even for different functions in a certain time as well[2].

5.0 Conclusion and recommendations

The study has been conducted with a view to explore the idea of flexibility in multifunctional design Architecture in a transit hajj camp building. It is concluded, that the selected transit hajj camps in spite of some technical weakness lead to inability for the usability of some functional spaces, for changing condition and new demands of its undefined users. Therefore the National Hajj Commission of Nigeria (NAHCON) should as a matter of change in corporate policies that could encourage the design of multifunctional flexible structures in all the existing Hajj trasit camps that are currently functioning as Hajj camp Buildings, serving as periodic structures to be multifunctional camp to encourage revenue generation, and to accommodate more activities for better usability of the structure. In addition Kano transit Hajj camp should consider other activities to be performed in the camp after the none hajj period to accommodate flexibility changes conditions.

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