

An Approach to Studying and Evaluating Sustainable Construction Technology in low-cost Housing Projects, Focusing on the Greater Khartoum Region

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Date of Submission: 20-01-2024

Date of Acceptance: 30-01-2024

ABSTRACT

One of the biggest issues facing residents today, particularly those with low incomes, is the shelter crisis. However, money is lost in the process. Inflation caused citizens' purchasing power to rise faster, making it more difficult to provide every family with healthy, economically and socially acceptable housing in a suitable residential setting that meets the necessities for a good life. The large number of low-income people in developing countries and the small number of people enjoying decent housing continue to exacerbate the shelter problem despite the accumulation of solutions and the multiplicity of government programs, both central and local, in the process of implementing "ambitious" programs for low-income housing. The study employed both qualitative and quantitative approach to design hypothesis and arrive at conclusion. Speaking with specialists in Khartoum, Khartoum Bahri, and Omdurman about the findings: Based on the arithmetic average of the data, the study demonstrated a high degree of agreement between the energy efficiency component and the application of sustainable building technology (3.91). Using natural lighting to illuminate the building during the day and also benefiting from it by storing and lighting it at night shows the research sample's view and understanding of the necessity of energy efficiency and usage of sustainable building technologies.

Keyword: Energy efficiency, Building energy, Khartoum building

I. INTRODUCTION

The housing problem is considered one of the major dilemmas facing citizens and decision-makers alike in major cities in developing countries, and Sudan is among the countries where

it appears to be more severe[1]. The shelter crisis has become one of the main problems that citizens suffer from, especially those with limited income. On the other hand, income is lost. Citizens' purchasing power increased more quickly due to inflation, which led to the difficulty of providing healthy, economically and socially appropriate housing for every family in a suitable residential environment that provides the minimum requirements for a decent life[2]. The living reality is that the incomes of the vast majority of citizens are unable to meet basic needs such as food, clothing, medicine, and what the family can spend on housing, while the cost of housing itself is increasing in size, which has led to the accumulation of families in narrow housing units and the spread of random housing that lacks the most basic requirements for a decent life. These are considered strong evidence of the exacerbation of the shelter problem in rapidly growing Sudanese cities, which dramatically presents the phenomenon of economic, social, political and environmental deterioration, and thus has resulted in major obstacles to sustainable social and economic development and transformation[1]. Despite the accumulation of solutions and the multiplicity of government programs, both central and local, in the process of implementing "ambitious" programs for low-income housing, the shelter problem continues to be exacerbated by the large number of low-income people in developing countries and the small number of people enjoying decent housing.

Current housing policies often tend to limit these participations, despite the inability of governments to confront the establishment of public housing projects to provide adequate shelter on their own, and the supply of housing units is always less than the demand due to the large

number of urban residents and the limited financial resources of governments, which requires concerted official efforts. And popularity in order to pursue a new economic solution to the shelter problem, distancing itself from the policies of public housing projects to provide adequate housing[3]. This global focus and growing dialogue at all levels and contributions from various professionals led to the development of concepts, and housing emerged as a field with clear diversity in its facets and specializations as an interlocking package: planning, urban, technical, economic, social, political, legal, environmental and aesthetic. The idea of housing as a basic right is no longer there. Human rights are an area of disagreement. The construction sector is considered one of the largest consumers of energy, material resources, and water, and a major polluter of the environment, in addition to the large waste that occurs in the construction sector at all its stages. It is also necessary to define sustainability standards for residential buildings in order to evaluate the sustainability of these buildings in order to start in this field, as well as the importance of Sustainability standards are relative according to the circumstances and environment of each country, so that it helps in knowing the priorities during design to focus on the standards with the greatest relative importance. There is currently no information about the level of achieving sustainability elements in buildings in Sudan[4].

II. RELATED WORK

There are many studies that have discussed the issue of urban growth in the beneficial world and the impact of this growth on the housing sector in terms of its expansion and how to address it, in addition to studies of the greater city of Khartoum from several aspects, including the history of the city and its expansion since Turkish trade until the present day, Francisco Land. Below we review an aspect of this[5]. Study in [6] and talked about Greater Khartoum. One of them focused on public housing in areas of the poor or low-cost housing. The study in[5] aim was to cover the problems of housing and living conditions. At the conclusion of the study, he emphasized his need The area is subject to a new housing plan, as it was proposed to house the citizens of Barre in their current places, taking into account future population growth. Study in [7] discussed the issue of appropriate design of the residential plot and social factors, taking into account the economic cost and the privacy of family members, especially women. Finally, he

concluded to reduce the problem by having the state contribute to building ownership of homes for the poor.

Author in [1] suggest on the supply and demand for housing, in addition to a detailed explanation of the sources of housing financing, he praised the role of the private sector in financing residential homes, but one of the problems facing housing in that period was the small income of the citizen. To solve these problems, he suggested that an amount be deducted. A certain amount of the monthly salary of any employee or worker with limited or low income, which appears in the accounts of any department or institution, and is called (reserve money for housing). In another book, it talks about illegal residential areas (slums), by [8], through the approach of comparison and analysis of practical study areas. The study included basic human needs, thus clarifying the extent of man's relationship with housing. It becomes clear that housing is not a space for shelter or to protect humans from nature, but rather It affects and is affected by the changes that occur to the social, economic and political situation among members of society and the extent of their impact on the surrounding environment. In another part of the study, the problem of housing in the Third World is addressed.

In terms of the reasons that led to the exacerbation of the problem, he concluded that the management of human settlements is an influential and effective factor in ensuring a degree of order in the growth of settlements and recommended enabling low-income classes to obtain goods and services related to housing units and related to all economic and social activities. A study by [9], which aimed to study the trend of financing housing projects and the entities funding these projects. Among them we mention: projects funded by the state and others funded by government departments and institutions.

There is indirect financing provided by institutions investing in the field of housing. He also touched on the experience of the Real Estate Bank in financing housing projects and explained the problems that hinder financing. Finally, the paper concluded that relying on the public sector to finance various housing activities is no longer the ideal option for addressing housing financing issues. The following was recommended to support the Housing and Planning Authority in a manner commensurate with the importance and diversity of sources of financial support. This agency aims to encourage and support the local building materials industry to create relative stability in prices and

thus reduce costs, establish joint projects between the private and public sectors, educate citizens and prepare them to accept the ideal model of housing, especially apartments, to reduce residential spaces. A study by [10], which aimed to talk about the impact of population density on the environment in residential areas through scientific analysis of the field study of third-class neighborhoods in the greater city of Khartoum. The researcher concluded that environmental conditions are deteriorating and could worsen as a result of several reasons, the most important of which is high population density, and the poor general housing policies of the state, in addition to the deteriorating economic situation of the region's residents. The research showed that the population of the study area is constantly increasing in the same area or neighborhoods, due to weak access to Housing plans or the inability to build new housing units. As a result, we find that one house has become a shelter for more than one family. The research came out with the following recommendations: The area of the housing unit must be sufficient for the requirements of the existing and extended family. Housing policies should be changed towards services in order to prevent the deterioration of the environmental situation in the complexes. Residential, conducting social economic studies that help predict population variables.

The study [11], which aimed to talk about the definition of housing and the number of its types present in the study area in Greater Khartoum, by the researcher [12]. It is a planned type and is distinguished by the availability of spaces necessary for services, and the re-planning pattern is characterized by the variation in the area of houses, which reached an average of 620 square meters, but the locations of this type It suffers from a lack of sufficient space to introduce and expand services, a random pattern, and the residents of this area suffer from a lack of planning, which has led to the lack of social services and a low standard of living. And the deterioration of the social environment, the pattern of dealing with informal housing, which is housing that is owned by the citizen through installments, but these complexes have not provided services since their implementation, but rather services were introduced to them after living in them, and these complexes were planned and the homes were owned by the citizens, and the study reached several results, including: The high population density has a clear impact on the low level of services in the four regions, in addition to that Areas

have a direct impact on each other, especially slum areas that negatively affect planned areas. One of the most important recommendations of the study is implementing housing plans to alleviate the problem in addition to planning slum areas and re-planning villages and cities. It also recommended working to stop the increasing migration from the countryside to cities as it is the reason.

2.1 Fundamental to the Housing Crisis.

Study by [13] which aimed to pay attention to a study that traces the emergence and growth of the urban city of Khartoum to Rahma to evaluate the problems resulting from the increase in urban area, by choosing an optimal method of growth to occupy the available resources to exploit it well. The study reached the pros and cons of housing policies and future directed plans. Its applications include rationalizing the use of land for the purpose of housing by reducing the minimum areas of residential plots for all grades so that tests other than income are taken into account with regard to the distribution of residential plots, increasing the number of residential units through vertical expansion in specific places in the city, and providing infrastructure, especially building materials, at reasonable prices.

A study by [14], which saw that Khartoum's location qualified it to be attractive to residents from neighboring areas, and this negatively affected the horizontal expansion of the city in all directions. Random housing appeared, making it difficult to know the city's borders as it merged with neighboring villages. The study came out with several results. Among them is that the large horizontal expansion of Khartoum has had a negative impact on the availability of infrastructure, in addition to the urban appearance of the city, as the features of the city disappear as we move away from the city center. A number of recommendations were made, including the necessity of vertical expansion to reduce the severity of horizontal expansion, in addition to reducing the area of residential plots, as well. Breaking the dominance of Khartoum's attractiveness to the population and developing the countryside in order to achieve the required urban balance.

[15] in which took the city of Al-Thawra as an example, touched on the rapid growth of the city as a result of migration, displacement, and natural increase, which led to pressure on the city's available infrastructure resources, so that there was a disparity in the form of buildings and residential areas, and it reached the following results:

Competition for housing and the increasing need for it multiply as we move towards urban areas, unlike the case in the countryside and villages. It recommended giving the housing sector more attention by allocating the appropriate amount of capabilities and investments to meet the increasing demand for housing, in addition to encouraging private or foreign capital to invest in the housing sector. A study by [16, 17] that aimed to evaluate the housing treatment policy and urban housing policies in Greater Khartoum as one of the cities of developing countries through guidelines that are appropriate to the circumstances of this city, and take into account the official policies circulated by the responsible authorities in Khartoum to address the two problems, and then highlight Its results for planners and decision makers when planning the urban housing sector in major cities, and the research concluded that applying scientific methods in evaluating policies to address informal housing circulating in Khartoum continuously[7]. These practices help to avoid failure sites, and lead to the development of treatments and the inclusion of these areas within the urban fabric. Also among the results is the failure of plans and strategies for the housing sector in Sudan, which has exacerbated the problem of housing in general and slum housing in particular. I recommend that residents of slum areas must participate in reviewing and evaluating the policies followed to implement these treatments, especially in developing countries, to ensure the satisfaction of the project beneficiaries and encourage them to contribute to the development of these areas[18].

The study in [19], which dealt with the housing problem during successive governments and focused on the period of the current government from 1989 to 2001 AD, then dealt with the treatments proposed by Khartoum State, which were represented by the site and services project, popular and investment housing projects, treatment of informal housing, and the organization of villages. The research reached several results, the most important of which is that the slowdown in implementing housing plans on time and the failure to implement or provide services in them is the main reason for the existence of the housing problem in Khartoum State, in addition to the increasing migrations towards and from the state. Finally, a study indicated that residential use has the largest share. The largest use of the increase in population in the greater city of Khartoum was by[15]. His study concluded that there is a large encroachment on land by citizens and the state, both legally and illegally, to meet the growing need

for housing as a result of the large increase in the state's population in the absence of housing plans. The study recommended thinking and working on vertical expansion as an alternative to horizontal expansion, supporting the housing sector from the state and increasing its budget, finding means and methods for partnership between the public and private sectors to implement ready-made housing projects, making guided housing plans and implementing them in a timely manner to meet the citizen's need for housing, stopping horizontal expansion and seeking vertical expansion. Breaking the dominance and attractiveness of Khartoum to the population, reducing the area of residential plots

III. METHODOLOGY

This section described the methodology adopted for this research and how it was conducted, the section include: data collection, Measures and data analysis.

3.1 Data Collection Procedure

The quantitative data collection approach is commonly used in data collection and analysis as reported in [9]. Similarly, this study adopted a similar research method for data collection and analysis from participants. The descriptive and analytical approach will be used, where the study model will be developed based on the analysis of previous literature related to the subject of the study, and the study tool represented by the questionnaire will be developed based on the opinions of arbitrators and experts. Primary data for the study was collected

From the study population that was selected from the telecommunications companies in Jordan, to accurately describe the phenomenon, know its size and degree of association with other phenomena, examine the relationships between the study variables and interpret them, and statistical methods were used that are compatible with analyzing the study data, testing its hypotheses, and answering its questions, which are considered The most appropriate methods for this type of study. Based on the context of this research objective the following research questions (RQ) were investigated:

- 1 What is sustainable construction technology in low-cost housing projects focusing on the greater Khartoum region from the point of view of experts, workers and the local community?

The following sub-questions branch out from the main question 1. What is the level of sustainable construction technology in low-cost housing projects focusing on the greater Khartoum region from the point of view of workers?

- a) What is the level of sustainable construction technology in low-cost housing projects focusing on the greater Khartoum region from the point of view of the community (low-income people)?
- b) What is the level of sustainable construction technology in low-cost housing projects in their dimensions (energy efficiency, site sustainability (natural systems), resource and material management, society and interaction between residents, economic aspects, services, business) focusing on the greater Khartoum region from the point of view of experts ?
- c) Are there statistically significant differences for sustainable construction technology in low-cost housing projects from the point of view of the study sample (workers) in Greater Khartoum State due to the variable (job, number of years of experience, age in years, field of construction technology)?
- d) Are there statistically significant differences in sustainable building technology in low-cost housing projects from the point of view of the study sample (of limited-income people) in Greater Khartoum State due to the variable (number of family members, occupation of the head of the family, average age of the head of the family, average family income in pounds)
- e) Are there statistically significant differences in sustainable building technology in public housing projects in all their dimensions from the point of view of the study sample (a community sample of experts in the field of building technology) in Greater Khartoum State due to the variable (job, number of years of experience, field of building technology, age in years)

3.2 Data Collection Procedure

The study start with the study population consisting of working individuals: The study population consisted of a group of working individuals consisting of (engineer, technician, and worker) in the field of architecture, civil engineering, electrical engineering, and surveying engineering, in the cities of Khartoum, Khartoum Bahri, and Omdurman. The study sample consisted of a group (engineer, technician, worker). The

sample was taken by a simple random method and was determined to be a size of (384) individuals. (384) questionnaires were distributed, (363) questionnaires were retrieved, and after examination, (13) questionnaires were excluded. The number of questionnaires suitable for analysis was (350) questionnaires for workers in the field of construction technology, with a percentage of (91.1%).

The second procedure deals with the study population consisting of people with limited income: The study population consisted of a group of families with limited income, consisting of (employee, craft work, other businesses), in the cities of Khartoum, Khartoum Bahri, and Omdurman. The sample was taken by a simple random method and was determined to be a size of (384) individuals. (384) questionnaires were distributed, (363) questionnaires were retrieved, and after examination, (13) questionnaires were excluded, and the number of questionnaires suitable for analysis was (350) questionnaires for people with income. Ltd. in the field of construction technology, with a percentage of (91.1%).

The third deal with the study population consisting of experts: The study population consisted of a group of experts with the following titles (engineer, technician, worker) in the field of architecture, civil engineering, electrical engineering, and surveying engineering, in the cities of Khartoum, Khartoum Bahri, and Omdurman. The sample was taken by simple random method and was determined to be a size of (384) individuals. (384) questionnaires were distributed, (340) questionnaires were retrieved, and after examination, (10) questionnaires were excluded, and the number of questionnaires suitable for analysis was (330) questionnaires for experts in the field. of Construction technology (85.9%).

3.3 Data Collection Sources

The researcher relied on two sources to collect data to achieve the objectives of the theoretical and practical study. The secondary data was obtained by reviewing the literature related to the study variables from books, research papers, and articles published in peer-reviewed journals, periodicals, and scientific dissertations published on databases to cover the theoretical framework and clarify the various aspects and main concepts of this study. Furthermore, the primary data was collected through a questionnaire that was designed and developed based on previous studies and

literature related to the research topic, and based on the supervisor’s opinions to verify the veracity and clarity of the paragraphs, their suitability to the objectives of the current study, the linguistic soundness of its vocabulary, and its ability to measure the dimensions of variables. The study, and their opinions, observations and viewpoints were taken into account

3.4 Measurement Scale

The questions were organized based on the three items . To answer the question each participant is required to indicate the level of agreement and disagreement with the statements using the concept of a five-point Likert scale from strongly disagree (1) to strongly agree (5) as shown in Table 1.

Table 1. Measurement scale

Scale	1	2	3	4	5
Measurement	Disagree	Disagree	Neutral	Agree	Strongly agree

More than 300 participants were selected to participate. The expected time to complete the questionnaire is estimated to be 20 minutes. Figure 1 show the research survey design model used in the study.

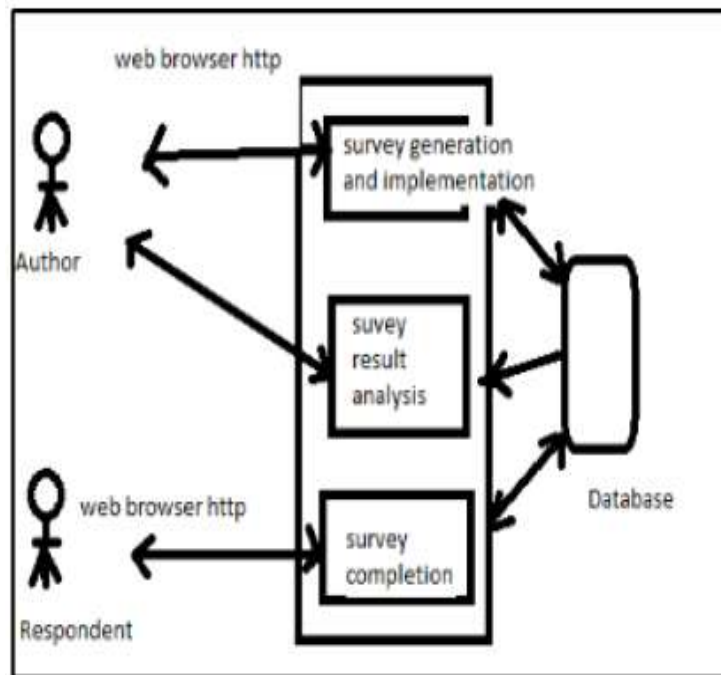


Figure 1 model of the data collection

3.5 Study Tool

The study tools consisted of studying the community of working individuals which used to generate the questionnaire attached in Appendix No. (1) consisted of three parts as follows:-

The first part includes demographic variables for the sample, which are (job, number of years of experience, field of construction technology, age in years), the second part is related to the measure of the independent variable (sustainable building technology in low-cost housing projects for workers) and were measured

through (9) questions and the third part:includes optional sample questions

The study tool also include studying the low-income community which includes demographic variables for the sample, which are (number of family members, occupation of the head of the family, average family income in pounds, average age of the head of the family in years). It also deal with the measure of the independent variable (sustainable building technology in low-cost housing projects for people with limited income) and was measured through

(47) questions. The optional questions includes demographic variables for the sample, which are (job, number of years of experience, field of construction technology, age in years). Meanwhile the second part of the optional part related to the measure of the independent variable (sustainable building technology in low-cost housing projects for experts) and seven main dimensions were taken, which are (efficiency and use of energy, sustainability of the site (natural systems), management of resources and materials, society and interaction between residents, economic

aspects, services , business), and it was measured through (28) questions

According to a five-point Likert scale for answer alternatives for each item, which was used to analyze the data according to the following equation:

$$\text{Category length} = (\text{upper limit of the scale} - \text{lower limit of the scale}) / \text{number of categories}$$

Calculate the category length = $(5-1) / 3 = 4/3 = 1.33$, then add the category length to the end of each category, so the evaluation level as presented in Table 2.

Table 2 Category length

Class	Category
Low	2.33-1
Medium	2.33-3.67
The high	2.67-5

3.6 Validity of the Study Tool

Content validity: It was verified by reviewing theoretical literature in previous studies, books, periodicals, articles published in peer-reviewed journals, and scientific theses published on the university library databases.

Apparent validity: It is used to determine the apparent validity of the study tool (the questionnaire) by judging its questions by the academic supervisor of the thesis and a number of specialized faculty members, and in light of their comments, some paragraphs of the questionnaire were reformulated.

3.7 Stability of Study Tools

To ensure the stability of the study tool; The value of Cronbach's alpha coefficient was measured to clarify the extent of the internal consistency of the study items, and to clarify the degree of stability of the structure of the questionnaire items, and the strength of their cohesion. Table 3 shows the reliability coefficient for the study measures, where the alpha values ranged between (0.774) as a total value, which is greater or It is equal to (0.60), which is acceptable in previous studies with a total number of items (9), which is a high value (see Table 3).

Table 3 Reliability coefficient values Cronbach's alpha reliability coefficient values for workers in the field of construction technology for the study scales

variable	Number of paragraphs	The value of the validity and reliability of the questionnaire, Cronbach's alpha
Sustainable construction technology in low-cost housing projects for workers	9	.774

3.8 Stability of a Study Tool for People with Limited Income

To ensure the stability of the study tool; The value of Cronbach's alpha coefficient was measured to clarify the extent of the internal consistency of the study items, and to clarify the degree of stability of the structure of the

questionnaire items, and the strength of their cohesion. Table 4 shows the reliability coefficient for the study's measures, where the alpha values ranged between (0.923) as a total value, which is greater or equal to (0.60), which is acceptable in previous studies with a total number of items (47), which is a high value.

Table 4 Cronbach’s alpha reliability coefficient values for people with limited income in the field of building technology for the study scales and for people with limited income for the study scales

variable	Number of paragraphs	The value of the validity and reliability of the questionnaire, Cronbach's alpha
Sustainable construction technology in low-cost housing projects for people with income	47	0.923

3.9 The stability of the Expert Study Tool

To ensure the stability of the study tool; The value of Cronbach's alpha coefficient was measured to clarify the extent of the internal consistency of the study items, and to clarify the degree of stability of the structure of the questionnaire items, and the strength of their

cohesion. Table 5 shows the reliability coefficient for the study’s measures, where the alpha values ranged between (0.883) as a total value, which is greater or equal to (0.60), which is acceptable in previous studies with a total number of items (28), which is a high value.

Table 5 Cronbach’s alpha reliability coefficient values for experts in the field of construction technology for the study’s scales

variable	Number of paragraphs	The value of the validity and reliability of the questionnaire, Cronbach's alpha
Construction technology in popular construction projects for experts in the field of construction technology	28	0.883

Statistical analysis methods

The Statistical Package for the Social Sciences was used to answer the study’s questions and test its hypotheses, which are as follows:

First: Descriptive statistics methods

It aims to describe the demographic characteristics of the study sample, and included the following:

Frequencies: to describe personal and job characteristics.

Percentages: to measure frequency distributions.

-Arithmetic mean: to measure the average of the study sample’s answers to the questionnaire items

-Standard deviation: To measure the extent to which answers are dispersed from their arithmetic mean.

Second: Analytical statistics:

Cronbach Alpha reliability coefficient: to determine the consistency of the study measures.

Variance test (ANOVA) to test the second sub-hypothesis of the first, second and third main hypotheses.

Ensuring the suitability of the study model

Normal distribution

First: The normal distribution of people with limited income

Table 6 Normal distribution of data for people with limited income in the field of building technology based on the skewness factor (Skewness)

The field	Torsion coefficient	Kurtosis coefficient
Sustainable construction technology in low-cost housing projects for low-income people	0.283-	0.255-

It is clear from the table above that the value of skewness was between (1-1.1), and this supports that all values are close to a normal distribution, and thus allows the use of parametric statistical methods.

Second: The normal distribution of working individuals

Table 7 indicates the Skewness test to demonstrate the normal distribution of the study data.

Table 7 Normal distribution of data for workers in the field of construction technology based on the Skewness coefficient

the field	Torsion coefficient	Kurtosis coefficient
Sustainable construction technology in low-cost housing projects for workers	0153-	0525-

It is clear from the table above that the value of skewness was between (1-1.1), and this supports that all values are close to a normal distribution,

and thus allows the use of parametric statistical methods.

Third: Normal distribution of experts:

Table 8 Normal distribution of data for experts in the field of construction technology based on the Skewness coefficient

the field	Torsion coefficient	Kurtosis coefficient
Sustainable construction technology in low-cost housing projects	-0.065	0411-

It is clear from the table above that the value of skewness was between (1-1.1), and this supports that all values are close to a normal distribution, and thus allows the use of parametric statistical methods.

Presentation of the analysis results of the study, arithmetic means and standard deviations, and testing of hypotheses for individuals working in the cities of Khartoum, Khartoum Bahri, and Omdurman. The study starts with participant demographic details such as years of experience, age, gender and specialization in the cities of Khartoum, Khartoum Bahri, and Omdurman: The result of this analysis is presented in Figure 2. Figure. Figure indicate that those with the job position (worker) constitute the largest percentage of the study sample's individuals, at a rate of (35.3%), and the smallest percentage was for those with the job as a technician, at a rate of (30.9%).

3.10 Data Analysis

This chapter provides an illustrative presentation of the results of the statistical analysis of the demographic variables, the results of the statistical analysis of the arithmetic means and standard deviations, and the testing of hypotheses, which clarify the nature of the relationships between the variables, and the degree of their influence on the dependent variable and its dimensions.

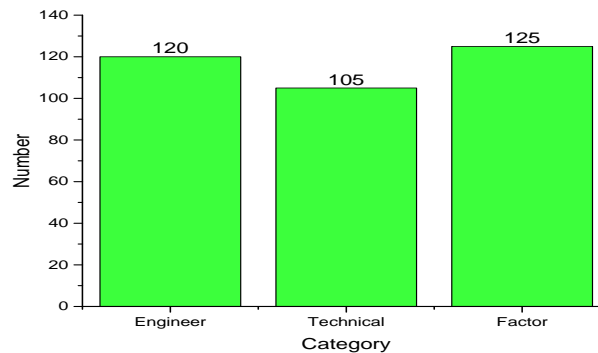


Figure 2 Function of the participants

Figure 3 also indicate that those with the number of years of experience (from 3 to less than 6 years) constituted the largest percentage of the individuals in the study sample at a rate of (30.6%), and the smallest percentage was among those with the number of years of experience (less than 3

years) at a rate of (21.5%), and that from the field of technology Construction (civilian) made up the largest percentage of the study sample (26.5%), and the smallest percentage was for those in the field of construction technology (electricity) with (21.8%).

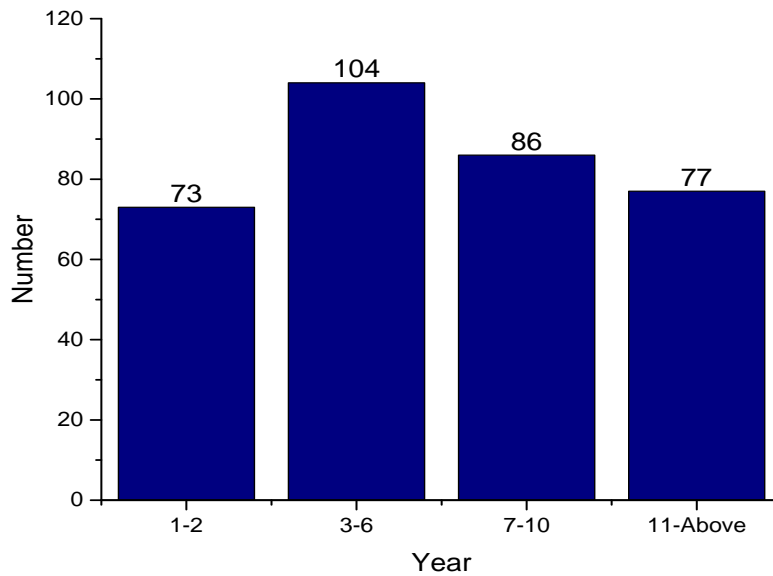


Figure 4 Year of experience

The Figure 5 explains the demographic information of participants in the survey (see Figure 5). The four categories of age groups of respondents falls between 20 – 30 age group is 29% % i.e. 95; the age group between 31-40 is

27% i.e. 92 respondents; the third group is between 41-50 is 27% i.e. 92 and lastly, the age group between 50 and above is 17%, which is 61 respondents.

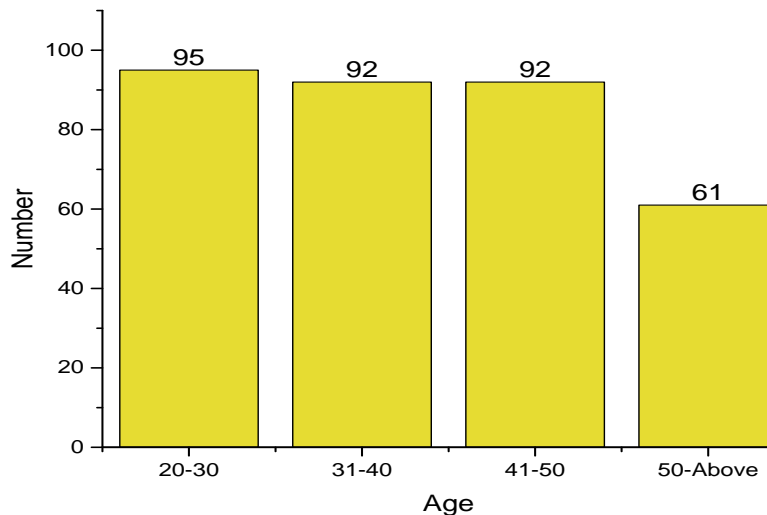


Figure 5 Age of the participant

Moreover, the number of participants based on gender shows, males constitute 77.1% and females constitute 22.9% (see Figure). Table (4-1)

Distribution of the study population according to demographic variables for workers in the field of construction technology

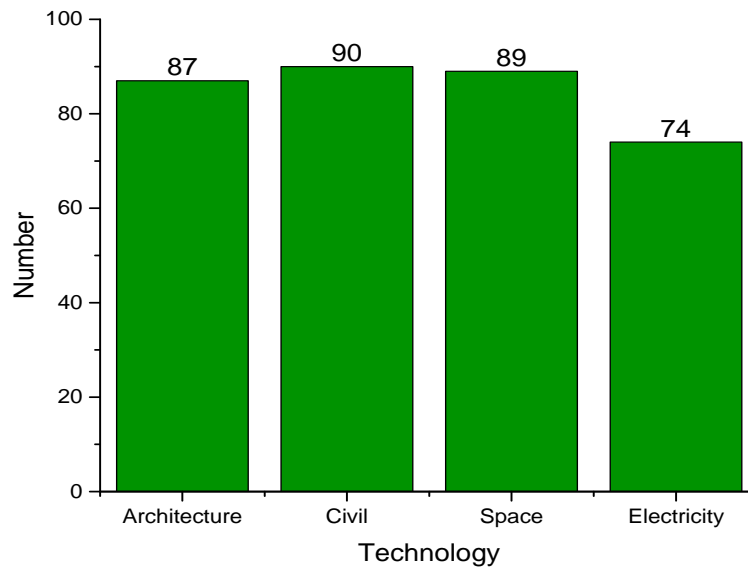


Figure 6 Field of construction technology

To answer the first research question: What is the level of sustainable construction technology in low-cost housing projects, focusing on the greater Khartoum region, from the point of view of workers?

To answer the second question: The arithmetic means, standard deviations, and relative importance were analyzed (see Table 9-Table 11). Table 9 represents arithmetic means and standard deviations of respondents' answers to items on sustainable building technology for workers in low-cost housing projects. It is clear from Table 9 that the most important items on sustainable building technology in low-cost housing projects were "Do you need to change part of the functional relationships during implementation to suit the requirements?" with a mean of (4.06), and the lowest percentages are paragraph (3) with a mean of (3.66). It indicates (when you design the plan, do you take into account the demographic structure and the future increase of extended families) with a total number of paragraphs (9) and an arithmetic average of (3.86). It is also clear that from Table 9 that the most important items on sustainable building technology in low-cost housing projects were "Do you need to change part of the functional relationships during implementation to suit the requirements?" with a mean of (4.06), and the lowest percentages are paragraph (3) with a mean of (3.66). It indicates (when you design the plan, do

you take into account the demographic structure and the future increase of extended families) with a total number of paragraphs (9) and an arithmetic average of (3.86).

Third: Testing hypotheses according to demographic variables for individuals working in the cities of Khartoum, Khartoum Bahri, and Omdurman:

Ho.2 The first main hypothesis: There are no statistically significant differences at the level ($\alpha \leq 0.05$) for sustainable building technology in low-cost housing projects from the point of view of the study sample (workers) in Greater Khartoum State due to the variable (job, number of years of experience, age). In years, the field of construction technology). There are no statistically significant differences at the significance level ($\alpha \geq 0.05$) in sustainable construction technology in low-cost residential projects from the point of view of the study sample (a community sample of workers in the field of construction technology) in Greater Khartoum State due to the variable (job). To test this hypothesis, the arithmetic mean difference test and the ANOVA test were used to find statistically significant differences at a significance level ($\alpha \leq 0.05$) in sustainable construction technology in low-cost housing projects from the point of view of the study sample (a community sample of workers in the field of construction technology) in the state of Greater Khartoum is attributed to the variable (job) (see Table 9).

Table 9 means in sustainable construction technology in low-cost housing projects from the point of view of the study sample

Construction technology in popular residential projects							
ANOVA			Report				
Sig F	Statistical significance	Value F	Degree of freedom	Standard Deviation	SMA	Number	Function
.041		3.230	2	0.440	3.786	115	Engineer
			337	0.461	3.938	105	Technical
			339	0.432	3.865	120	Factor
				0.447	3.861	340	Total

Data from Table 10 indicate that, there are statistically significant differences in the items on sustainable building technology in low-cost housing projects in light of the variable (job), where the arithmetic mean values were as follows: engineer, technician, worker (3.786, 3.938, 3.865), respectively, and the value of F (3.230) is significant at the significance level (0.041), which is less than 0.05. From the above, we reject the null hypothesis that there are no statistically significant differences at a significance level ($\alpha \leq 0.05$) in sustainable building technology in low-cost housing projects from the point of view of the study sample (sample Community for workers in the field Building technology in Greater Khartoum State is attributed to the variable (job). We accept the alternative hypothesis that there are statistically significant differences at a significant level ($\alpha \leq 0.05$) in sustainable building technology in low-cost housing projects from the point of view of the study sample (a community sample of workers in

the field of technology Construction) in Greater Khartoum State is attributed to the variable (job). There are no statistically significant differences at the significance level ($0.05 \geq \alpha$) in sustainable building technology in low-cost housing projects from the point of view of the study sample (a community sample of workers in the field of construction technology) in Greater Khartoum State due to the variable (number of years of experience).

To test this hypothesis, the arithmetic mean differences test and the ANOVA test were used to find statistically significant differences at a significance level ($\alpha \leq 0.05$) in sustainable construction technology in low-cost housing projects from the point of view of the study sample (a community sample of workers in the field of construction technology) in the state of Greater Khartoum is due to the variable number of years of experience (see Table 10).

Table 10 means in sustainable construction technology in low-cost housing projects from the point of view of the study

Construction technology in popular residential projects							
ANOVA			Report				
Sig F	Statistical significance	Value F	Degree of Freedom	Standard Deviation	SMA	Number	Years of Experience
393	.099		3	0.446	3.808	73	Less than 3 years
			336	0.456	3.908	104	From 3 to less than 6 years
				0.433	3.824	86	From 6 to less than 10 years
				339	0.450	3.886	77
			0.447		3.861	340	Total

Data from Table 11 demonstrate that there are no statistically significant differences in the items on sustainable building technology in low-cost housing projects in light of the variable

(number of years of experience), where the arithmetic average values were as follows: less than 3 years, from 3 to less than 6 years, From 6 to less than 10 years, 10 years and more (3.808, 3.908,

3.824, 3.886), respectively, and the F value (0.999) is not significant at the significance level (0.393), which is greater than 0.05. From the above, we accept the null hypothesis.

There are no statistically significant differences at a significant level ($\alpha \leq 0.05$) in sustainable construction technology in low-cost housing projects from the point of view of the study sample (a community sample of workers in the field of construction technology) in Greater Khartoum State due to the variable (number of years of experience). We reject the hypothesis. The alternative is that there are statistically significant differences at a significant level ($\alpha \leq 0.05$) in sustainable construction technology in low-cost housing projects from the point of view of the study sample (a community sample of workers in the field of construction technology) in Greater Khartoum State due to the variable (number of years of experience). There are no statistically significant differences at the significance level ($\alpha \geq 0.05$) in sustainable construction technology in low-cost housing projects from the point of view of the study sample (a community sample of workers in the field of construction technology) in Greater Khartoum State due to the variable (field of construction technology).

To test this hypothesis, the arithmetic mean differences test procedure and test were used. ANOVA to find statistically significant differences at a significant level ($\alpha \leq 0.05$) in sustainable construction technology in low-cost housing projects from the point of view of the study sample (a community sample of workers in the field of construction technology) in Greater Khartoum State due to the variable in the field of construction technology (see Table 11). There are no statistically significant differences at the significance level ($0.05 \geq \alpha$) in sustainable building technology in low-cost housing projects from the point of view of the study sample (a community sample of workers in the field of building technology) in Greater Khartoum State due to the variable (age). To test this hypothesis, the arithmetic mean difference test procedure and the test were used ANOVA to find statistically significant differences at a significant level ($\alpha \leq 0.05$) in sustainable construction technology in low-cost housing projects from the point of view of the study sample (a community sample of workers in the field of construction technology) in Greater Khartoum State due to the age variable (see Table 11).

Table 11 means in sustainable construction technology in low-cost housing projects from the point of view of the study

Sustainable construction technology in public housing projects						
ANOVA			Report			
Sig F Statistical Significance	valueF	Degree of freedom	Standard Deviation	SMA	Number	Age
0.615	0.601	3	0.449	3.881	95	From 20 to less than 30 years old
		336	0.440	3.824	92	From 30 to less than 40 years old
			0.446	3.842	92	From 40 to less than 50 years old
		339	0.460	3.913	61	50 years and over
			0.447	3.861	340	Total

Presentation of the analysis results of the study, arithmetic averages and standard deviations, and testing of hypotheses for people with limited

income in the cities of Khartoum, Khartoum Bahri, and Omdurman. The analysis of the demographic characteristics of people with limited income in the

cities of Khartoum, Khartoum Bahri, and Omdurman:

It is observed from Table 12 that the following is that of the number of family members (4 to 6) they constitute the largest percentage of the members of the study sample, at a rate of (71.7%), and the lowest percentage was for those of the number of family members (7 or more), at a rate of (7.1%). And that those with the job of head of the family (employee) constitute the largest percentage of the study sample's members at a rate of (42.3%), and the lowest percentage was for those with the job of head of the family (other work) at (26.3%). And that the average family income in pounds (out of 100 To less than) pounds constitute the largest percentage of the study sample members at a rate of (34.3%), and the lowest percentage was for those with an average family income in pounds (500 pounds or more) at a rate of (14%), and that of the average age of the head of the family (from 30 to less than 50 years) they constitute The largest percentage of the study sample was (85.4%), and the smallest percentage was of the average age of the head of the family (from 20 to less than 30 years) (2%).

Table 12 represents the distribution of the study population according to demographic variables for people with limited income in the field of construction technology. The analysis of the means and standard deviations for people with limited income in the cities of Khartoum, Khartoum Bahri, and Omdurman:

Results of the second question: What is the level of sustainable construction technology in low-cost housing projects focusing on the greater Khartoum region from the point of view of the community (people with limited income)? To answer the third question: Arithmetic means, standard deviations, and relative importance were analyzed (see Table 12).

Table 12 arithmetic means and standard deviations of respondents' answers to items on sustainable building technology for low-income people in low-cost housing projects view of the study sample (of limited-income people) in Greater Khartoum State due to the variable (number of family members, job of the head of the family, Average age of the head of the family, average family income in pounds

There are no statistically significant differences at the level of significance ($0.05 \geq \alpha$) in sustainable building technology in low-cost housing projects from the point of view of the study sample (a non-specialized community sample but related to the subject of the study) in Greater

Khartoum State due to the variable (number of family members).

To test this hypothesis, the arithmetic mean differences test and the ANOVA test were used to find statistically significant differences at a significant level ($\alpha \leq 0.05$) in construction technology. Sustainable low-cost housing projects from the point of view of the study sample (a non-specialized community sample but related to the subject of the study) in Greater Khartoum State is due to the variable (number of family members) (see Table 12).

HO3.2: There are no statistically significant differences at the significance level ($0.05 \geq \alpha$) in sustainable building technology in low-cost housing projects from the point of view of the study sample (a non-specialized community sample but related to the subject of the study) in Greater Khartoum State due to the variable (job of head of household).

To test this hypothesis, the arithmetic mean difference test and the ANOVA test were used to find statistically significant differences at a significance level ($\alpha \leq 0.05$) in sustainable building technology in low-cost housing projects from the point of view of the study sample (a non-specialized community sample but related to the subject of the study). In Greater Khartoum State, it is attributed to the variable of the job of the head of the household (see Table 12).

Table (4-10) Results of the difference-in-means test to find differences between the means in sustainable building technology in low-cost housing projects from the point of view of the study sample (a non-specialized community sample but related to the subject of the study) in Greater Khartoum State due to the variable (occupation of the head of the household)

The zero point indicates that there are no statistically significant differences at a significant level ($\alpha \leq 0.05$) in sustainable building technology in low-cost housing projects from the point of view of the study sample (a non-specialized community sample but related to the subject of the study) in Greater Khartoum State due to the variable (average income (family in pounds) and we reject the alternative hypothesis that there are statistically significant differences at a significant level ($\alpha \leq 0.05$) in sustainable construction technology in low-cost housing projects from the point of view of the study sample (a non-specialized community sample but related to the subject of the study) in Greater Khartoum State due to For the variable (average family income in pounds).

There are no statistically significant differences at the level of significance ($\alpha \geq 0.05$) in sustainable building technology in low-cost housing projects from the point of view of the study sample (a non-specialized community sample but related to the subject of the study) in Greater Khartoum State due to the variable (average age of the employer and family).

Not significant at the level of significance (0.261), which is greater than 0.05. From the above, we accept the null hypothesis that there are no statistically significant differences at the level of

significance ($\alpha \leq 0.05$) in sustainable building technology in low-cost housing projects from the point of view of the study sample (community sample). Not specialized, but related to the subject of the study) in Greater Khartoum State due to the variable (average age of the head of the household). We reject the alternative hypothesis that there are statistically significant differences at a significant level ($\alpha \leq 0.05$) in sustainable construction technology in low-cost housing projects from a sample point of view.

Table 12 arithmetic averages and standard deviations for sustainable construction technology in low-cost housing projects in the greater Khartoum region from the point of view of experts

Relative Importance	Standard Deviation	SMA	Paragraph	Rank
High	0.59	3.91	Energy efficiency and use	5
High	0.49	3.94	Site sustainability (natural systems)	2
High	0.54	3.87	Resource and materials management	6
High	0.48	3.92	Society and interaction between residents	3
High	0.42	3.92	Economic aspects	4
High	0.59	3.96	Services	1
High	0.49	3.80	Business	7
High	0.381	3.91	Total	

The study (a non-specialized community sample but related to the subject of the study) in Greater Khartoum State is attributed to the variable (average age of the head of the household). Presentation of the analysis results of the study, arithmetic averages and standard deviations, and testing of hypotheses to experts in the cities of Khartoum, Khartoum Bahariya, and Omdurman. The Analysis of the demographic characteristics of experts in the cities and analysis of the means and standard deviations of experts in the cities of Khartoum, Khartoum Bahri, and Omdurman:

Results of the third question: What is the level of sustainable construction technology in low-cost housing projects in their dimensions (energy efficiency, site sustainability (natural systems), resource and material management, society and interaction between residents, economic aspects, services, business) focusing on the greater Khartoum region from the point of view Expert opinion?

It is noted from Table 13 that sustainable building technology in public housing projects obtained a high score, as the arithmetic average reached (3.91), and came in first place after

“energy efficiency and use,” with a arithmetic average of (3.81), and came in second place. “Site Sustainability (Natural Systems),” with a arithmetical average of (3.94), and came in third place after “Resources and Materials Management,” with a arithmetical average of (3.87), and came in fourth place after “Community and Interaction among Residents,” with a arithmetical average of (3.92). It came in fifth place after “Economic Aspects”, with an arithmetic average of (3.92), and it came in sixth place after “Services”, with an arithmetic average of (3.96), and it came in seventh place after “Business”, with an arithmetic average of (3.80).The arithmetic means and standard deviations of the dimensions of sustainable building technology in low-cost housing projects were analyzed for the experts as shown in Table 13. The Solar energy (during the design of building energy systems) with a total number of items (3) and arithmetic average (3.91).

Table 13 shows the arithmetic means and standard deviations of respondents’ answers to items on site sustainability (natural systems). It is clear from Table 13 that the most important items for the sustainability of the site (natural systems)

were “Ease and flexibility of design, maintenance, reuse of the building and its ability to adapt” with an arithmetic mean of (4.03), and the lowest percentages are paragraph (2) with an arithmetic mean of (3.81) and indicates (to be achieved).

Taking into account the availability of basic services near the commercial area within a specific building area when choosing the construction site) with a total number of (5) paragraphs and arithmetic average (3.94).

Table 13 arithmetic means and standard deviations of respondents’ answers to Society and interaction between residents

IR	SD	SMA	Paragraph	Rank	Number
High	0.815	4.09	Study the initial cost of the project and establish flexibility so that housing is affordable	1	1
High	0.776	4.00	Flexibility and quality of design to reduce maintenance and operating costs	2	3
High	0.826	3.93	The cost of demolition and renovation is studied during the design process	3	4
Medium	0.576	3.67	Modern software and technologies are used when designing	4	2
High	0.416	3.92	Total		

It is clear from Table 14 that the most important paragraphs on society and interaction among residents were “Houses were designed and diversified according to societal groups” with a mean of (4.06), and the lowest percentages were paragraph (1) with a mean of (3.80) and indicates (labor is selected and industries and skills are used). Local) with a total number of paragraphs (4) and arithmetic average (3.92). Testing hypotheses according to the demographic variables of experts in the cities of Khartoum, Khartoum Bahri, and

Omdurman: the data from Table 14 shows there are no statistically significant differences at the level ($\alpha \leq 0.05$) for sustainable building technology in public housing projects with all their dimensions combined from the point of view of the study sample (a community sample of experts in the field of building technology) in Greater Khartoum State due to the variable (job, number Years of experience, field of construction technology, age in years).

Table 13 Testing hypotheses according to the demographic variables of experts in the cities of Khartoum, Khartoum Bahri, and Omdurman

IR	SD	SMA	Paragraph	Rank	No
High	0.934	4.06	Housing is designed and diversified according to societal groups	1	4
High	0.655	3.92	When designing, community participation in decision-making is activated to raise the level of sustainable awareness	2	2
High	0.555	3.89	Basic services were provided, including green spaces, sports facilities, and community facilities	3	3
High	0.729	3.80	Labor is selected and local industries and skills are used	4	1
High	0.475	3.92	Total		

HO1.1: There are no statistically significant differences at the level of significance ($\alpha \geq 0.05$) in sustainable building technology in public housing projects with their combined dimensions from the point of view of the study sample (a community sample of experts in the field of building technology) in Greater Khartoum State due to the variable (job). To test this hypothesis, the arithmetic mean difference test and the ANOVA test were used to find statistically significant differences at a level of significance ($\alpha \leq 0.05$) in sustainable building technology in public housing projects with their combined dimensions from the point of view of the study sample (a community sample of experts in the field of building technology). In Greater Khartoum State, it is attributed to the variable (job) (see Table 14).

To test this hypothesis, the arithmetic mean difference test procedure and the test were us ANOVA to find statistically significant differences at a significant level ($\alpha \leq 0.05$) in sustainable building technology in public housing projects with all its dimensions combined from the point of view of the study sample (a community sample of experts in the field of building technology) in Greater Khartoum State due to the variable number of years of experience. There are no statistically significant differences at the level of significance ($0.05 \geq \alpha$) in sustainable building technology in public housing projects with all their dimensions combined from the point of view of the study sample (a community sample of experts in the field of building technology) in Greater Khartoum State due to the variable (field of building technology).

To test this hypothesis, the arithmetic mean difference test and the ANOVA test were used to find statistically significant differences at a significant level ($\alpha \leq 0.05$) in construction technology. The largest is due to the variable (the field of construction technology), and we reject the alternative hypothesis that there are statistically significant differences at a significant level ($\alpha \leq 0.05$) in sustainable construction technology in public housing projects with all their dimensions combined from the point of view of the study sample (a community sample of experts in the field of construction technology) in Greater Khartoum State is attributed to the variable (construction technology field). There are no statistically significant differences at the level of significance ($\alpha \geq 0.05$) in sustainable building technology in public housing projects with all their dimensions combined from the point of view of the study sample (a community sample of experts in the field

of building technology) in Greater Khartoum State due to the variable (age).

To test this hypothesis, the arithmetic mean difference test and the ANOVA test were used to find statistically significant differences at a significant level ($\alpha \leq 0.05$) in sustainable building technology in public housing projects with all their dimensions combined from the point of view of the study sample (a community sample of experts in the field of building technology) in Greater Khartoum State is due to the age variable.

Zero results indicate that there are no statistically significant differences at a significant level ($\alpha \leq 0.05$) in sustainable building technology in public housing projects with all their dimensions combined from the point of view of the study sample (a community sample of experts in the field of building technology) in Greater Khartoum State due to the variable (age). We reject The alternative hypothesis is that there are statistically significant differences at a significant level ($\alpha \leq 0.05$) in sustainable building technology in public housing projects with all their dimensions combined from the point of view of the study sample (a community sample of experts in the field of building technology) in Greater Khartoum State due to the variable (age).

IV. DISCUSSING THE RESULTS AND RECOMMENDATIONS

This chapter provides a presentation to discuss the results, conclusions and recommendations, and the conclusion, which explains the nature of the relationships between the variables, the degree of their influence on the dependent variable and its dimensions.

4.1 Discussion of the results

Discussing the results for individuals working in the cities of Khartoum, Khartoum Bahri, and Omdurman : -The study showed that sustainable construction technology for workers in low-cost housing projects has a high degree of approval, as its arithmetic average reached (3.86). This indicates the study sample's perception and awareness of the importance of sustainable construction technology for workers in low-cost housing projects, and this is shown through The interior windows and openings are designed to take into account the principles of natural ventilation of the interior spaces (the design is not synonymous), as untrained workers lead to the appearance of defects during construction and implementation, which leads to frequent maintenance.

There is a statistically significant impact of sustainable construction technology on low-cost housing projects from the point of view of the study sample (a community sample of workers in the field of construction technology) in the state of Greater Khartoum is attributed to the variable (job, number of years of experience, age in years, field of construction technology). The value of F was (3.230), not significant at the level of significance (0.041), which is greater than 0.05 for the job. The value of F was (0.999), not significant at the level of significance (0.393), which is greater than 0.05 with respect to the number of years of experience. It reached (1.973) and is not significant at the significance level (0.118), which is greater than 0.05 for the field of construction technology, and the F value (0.601) is non-significant at the significance level (0.615), which is greater than 0.05 for age in years.

Discussing the results for people with limited income in the cities of Khartoum, Khartoum Bahri, and Omdurman: The study showed that sustainable construction technology for low-income people in low-cost housing projects has a high degree of approval, as its arithmetic average reached (3.91). This indicates the study sample's perception and awareness of the importance of sustainable construction technology. Low-cost housing projects, and this is shown by whether the individual skill of the workers affects the final implementation of the building when planning the residential area. Does it take into account the social composition, as the distribution of public services is adequate in terms of (public squares), as the distribution of public services is adequate in terms of (drainage) health) for workers. There is a statistically significant effect of sustainable building technology on low-cost housing projects from the point of view of the study sample (of limited-income people) in Greater Khartoum State due to the variable (number of family members, occupation of the head of the family, average age of the head of the family, average family income in pounds). . The F value was (0.031) and not significant at the significance level (0.358).

It is greater than 0.05 for the number of family members, as the F value reached (3.399) and is not significant at the significance level (0.035), and it is greater than 0.05 for the job of the head of the family. Also, the F value reached (1.005) and is not significant at the significance level (0.391), which is It is greater than 0.05 for the average family income in pounds, and the F value (1.341) is not significant at the significance level (0.261), and

it is greater than 0.05 for the average age of the head of the household.

Discussing the results with experts in the cities of Khartoum, Khartoum Bahri, and Omdurman: The study showed that the dimension of energy efficiency and use of sustainable building technology has a high degree of agreement, as its arithmetic average reached (3.91). This indicates the study sample's perception and awareness of the importance of energy efficiency and use of sustainable building technology, and this is shown through Using natural lighting to illuminate the building during the day and also benefiting from it by storing and lighting it at night

The study showed that the dimension of site sustainability (natural systems) for sustainable building technology has a high degree of agreement, as its arithmetic average reached (3.94), and this indicates the study sample's perception and awareness of the importance of site sustainability (natural systems) for sustainable building technology. This is demonstrated by taking into account the location's proximity to public transportation when choosing it, as the project's rainwater management system is designed to reduce the amount of water lost and exposed to pollution.

The study showed that the dimension of managing resources and materials for sustainable building technology has a high degree of approval, as its arithmetic average reached (3.87). This indicates the study sample's perception and awareness of the importance of managing resources and materials for sustainable building technology, and this is shown through the efficiency of environmental protection and utilization management. It collects, stores, treats and distributes rainwater for building purposes to reduce dependence on potable water

The study showed that the dimension of community and interaction among residents for sustainable building technology has a high degree of agreement, as its arithmetic average reached (3.92), and this indicates the study sample's perception and awareness of the importance of community and interaction among residents for sustainable building technology, and this is shown through that when designing Community participation in decision-making is activated to raise the level of sustainable awareness, as basic services have been provided, including green spaces, sports facilities, and community facilities

The study showed that the dimension of the economic aspects of sustainable building technology has a high degree of agreement, as the

arithmetic mean for it reached (3.92). This indicates the study sample's perception and awareness of the importance of the economic aspects of sustainable building technology, and this appears through the flexibility and quality of the design to reduce the cost of maintenance and operation. The cost of demolition and renovation is studied during the design process

The study showed that the services dimension for sustainable building technology has a high degree of agreement, as its arithmetic average reached (3.96). This indicates the study sample's perception and awareness of the importance of services for sustainable building technology, and this is shown by the fact that a network of roads and services with high efficiency is used. To reduce accidents, the distance between basic education facilities, health services, stores and facilities of daily use is studied.

The study showed that the business dimension of sustainable building technology has a high degree of approval, as its arithmetic mean reached (3.80), and this indicates the study sample's perception and awareness of the business importance of sustainable building technology, and this is shown through that planning and design are carried out by putting in place measures to reduce noise. Odor and light pollution (landscaping, environmental preparation, innovative cultural and regional practices, green buildings)

There is a statistically significant impact of sustainable building technology on public housing projects in all its dimensions from the point of view of the study sample (a community sample of experts in the field of building technology) in Greater Khartoum State due to the variable (job, number of years of experience, field of building technology, age in years). The value of F (0.341) was insignificant at the level of significance (0.711) and is greater than 0.05 for the job. The value of F was (2.149) and non-significant at the level of significance (0.094) and is greater than 0.05 with respect to the number of years of experience. Also, the value of The F value was (0.141) and insignificant at the significance level (0.935), which is greater than 0.05 for the field of construction technology, and the F value was (1.153) and insignificant at the significance level (0.328), which is greater than 0.05 for age in years.

V. STUDY RECOMMENDATIONS

First: Recommendations and proposals for individuals working in the cities of Khartoum, Khartoum Bahri, and Omdurman

.1.The need to take into account the demographic structure and the future increase of extended families

.2.The necessity of taking into account aesthetic aspects as a basic criterion for modular design

.3.It is necessary to take into account the quality of your choice of local or imported building materials when designing and implementing

Second: Recommendations and proposals for people with limited income in the cities of Khartoum, Khartoum Bahri, and Omdurman:

.1.The necessity of giving the contractor tools to carry out the work, and the long period of time granted leads to no obvious defects appearing in the implementation

.2.It is necessary to replace the design space of kitchens with a portion of the outdoor space to provide better access to meals and rest

.3.The need to distribute public services and to be adequate in terms of (education, security system, environmental health)

Third, the recommendations and proposals of experts in the cities of Khartoum, Khartoum Bahri, and Omdurman

.1.The necessity of exploiting renewable energy (such as solar energy) during the design of the building's energy systems

.2.Stimulating the availability of basic services near the commercial area within a specific construction scope when choosing a construction site

.3.Encouraging the use of local materials to avoid transportation difficulties and high costs

.4.The necessity of using local industries and skills.

.5.The necessity of using modern design programs and technologies

.6. Encouraging the design of pedestrian and bicycle paths, parking lots, and programs for monitoring and device maintenance.

7. Encouraging researchers to address the problem of housing evaluation in Khartoum, Khartoum North and Omdurman.

8. Motivating the Housing and Development Fund to play a major role in reducing costs, prices, and population policies

9. Encouraging citizens to participate in formulating policies related to housing

VI. FUTURE RESEARCH RECOMMENDATIONS

.1.Study studies on bodies financing services that provide loans specialized in comprehensive housing projects.

.2.A study on granting a low advantage on home loans with a voluntary interest in entitlement to homes, without burdening them financially.

.3.Design plans to develop government projects related to housing, and the consequent limited income limits, those with no income with a special specialization, and the percentage of private real estate for them due to their standard of living.

7.0 Study Limitation

1.The presence of political unrest that affected economically and socially the housing system in Sudan in general and in the Khartoum region, Khartoum Bahri and Omdurman in particular, which led to a delay in the delivery of many projects, and this negatively affected the citizen's desire to go to this sector.

.2.The researcher was unable to obtain the necessary data in the form required to complete the study due to the impact of the unrest in the country, which contributed to limiting the acquisition of data and information, whether from government departments, or collecting data in the field.

.3.Citizens' fear of providing the researcher with the necessary information and data, and their reluctance to fill out the questionnaires distributed to the study population, which forced the researcher to distribute the questionnaires electronically in cooperation with companies specialized in studies.

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