Toward Sustainable Housing Construction in Iraq

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ABSTRACT

Adopting a sustainable approach in processes and activities in the construction industry is considered one of the best strategies that support the direction of sustainability and promote the development of the green approach in this industry and contribute effectively to providing an environmentally friendly construction that contributes effectively to creating an environmentally friendly construction industry that produces sustainable residential buildings that achieve a balance between economic, environmental and social. Iraq is facing a large urban expansion with the increase in the population increase in the demand for electricity and water and the increase in the percentage of pollution in the environment, the construction sector has become one of the largest polluters of the environment in Iraq due to the absence of any sustainable approach. This study aims to find a viable approach to the transition toward sustainable housing construction in Iraq, as this study includes identifying the current problems that Iraq suffers from in terms of the construction sector, and environmental pollution. The research proposes adopting the concept of sustainability in the construction sector as a sustainable solution by converting conventional construction into sustainable construction for residential buildings in Iraq. In this research, the strategies that support the transition to sustainable housing construction will be identified, and an applicable approach by all stakeholders in the construction sector, as the application of this approach will lead to the development of the construction sector in general, develop and enhance the performance of all stakeholders in the construction sector, environmental protection and pollution reduction in addition to the others economic, social and environmental benefits that can be obtained when applying this approach.

Keywords: sustainable construction, conventional construction, sustainable development goals, sustainable house construction.

INTRODUCTION

The construction sector is one of the largest sectors that cause greenhouse gas emissions and waste generation accordingly and with the aim of reducing the carbon footprint, saving natural resources and protecting the environment from pollution, many countries of the world have developed strategies to adopt a sustainable building approach through enacting sustainable building laws and adopting global sustainable building specifications and standards, in addition to developing national building specifications and standards while integrating all sustainable construction concepts in the construction industry, while the construction industry in Iraq has not adopted any sustainable construction approach yet in this important industry and has not kept pace with sustainable development, as the construction industry in Iraq is one of the largest polluters of the environment and the largest consumer of energy and water, despite That the construction industry in Iraq is one of the largest vital industries that constitute a major axis of development due to the volume of business and investment in this important sector In addition to the large expansion of the population with an acute shortage of housing and residential buildings, where the shift towards

sustainable construction has become an environmental, economic and social necessity that requires adoption in the construction industry. This study suggests identifying and adopting applicable strategies for a transition toward sustainable housing construction in Iraq.

DEFINITION OF TERMS

Conventional Construction

[22] identified conventional construction as the traditional technique of production where the construction knowledge is passed from one generation to the other and where new technologies and materials are barely utilized is known as conventional building construction.

Sustainable Development

According to [20] sustainable development is the process of meeting the needs of current and future generations without diminishing the flexibility of life-supporting characteristics or the cohesion and integration of social systems. Sustainability consists of four dimensions, including:

- Economic systems and other activities.
- Ecosystem.
- Institutional performance and capabilities.
- Governance and political activism.

Sustainable Construction

The goal of sustainable construction is to create and operate a healthy built environment based on resource efficiency and ecological design with an emphasis on seven core principles across the building's life cycle: reducing resource consumption, reusing resources, using recyclable resources, protecting nature, eliminating toxins, applying life cycle costing, and focusing on quality [27].

Sustainable Homes

The UN-Habitat report provided an ideal description of the characteristics of sustainable homes that must be provided to ensure adequate housing that meets the requirements of the population and achieves healthy and comfortable housing for them, as these characteristics included:

- Healthy, durable, safe, and secure.
- Affordable for the whole spectrum of incomes.
- Using ecological low-energy and affordable building materials and technology.
- Resilient to sustain potential natural disasters and climatic impacts.
- Connected to decent, safe, and affordable energy, water, sanitation, and recycling facilities.
- Connected to decent, safe, and affordable energy, water, sanitation, and recycling facilities.
- Using energy and water most efficiently and equipped with certain on-site renewable energy generation and water recycling capabilities.
- Not polluting the environment and protected from external pollution.

- Well, connected to jobs, shops, health- and child-care, education, and other services.
- Properly integrated into, and enhancing, the social, cultural, and economic fabric of the local neighborhood and the wider urban areas.
- Properly run and maintained, timely renovated and retrofitted [42].

PROBLEM STATEMENT

The increase in population, huge urban expansion, environmental pollution, a severe shortage of housing units, a shortage of energy and water supplies, a lack of capacity, and old infrastructure in Iraq. This is the current situation in Iraq in general, while the construction industry has not adopted any sustainable approach and is still adopting a conventional construction approach in an attempt to meet the lack of housing and the large population and urban expansion, causing an increase in pollution and environmental deterioration, with an increase in energy and water shortages as a result of increased demand. Official statistics and many researchers have pointed to these, where the Iraqi national housing policy of the year 2010 which was prepared by the Ministry of Housing and Construction with the support of UN-Habitat indicated that one of the challenges facing housing in Iraq is the huge unmet demand for housing as the supply side, as current estimates indicate that about 2 million homes are needed in urban areas in Iraq by 2016. This represents 200,000 homes annually over the next ten years [30]. The housing sector in Iraq faces many challenges, including severe housing shortages, poor planning and design, lack of basic services, and inability to afford costs, especially among low-income groups, as for energy consumption and carbon emissions Iraq has been facing an acute energy crisis since 2003 and the residential sector represents the highest energy consumer on the demand side, while the World Bank estimates that the annual discharge of carbon dioxide in Iraq has increased from 84,540,890 tons in 2000 to 162,646,160 tons in 2016 of fossil fuels. [25].

[41] discussed that there are many problems related to the construction of residential complexes in Iraq, such as pollution, increased energy consumption, an increase in completion time, and the absence of human resources management, and relying on traditional methods of construction cannot solve the problem. [3] discussed that the population and economic growth in Iraq will lead to an increase in the energy demand. Whereas [8] argued that the missing government regulations regarding sustainable homes are an obstacle to implementing a sustainable approach. Where [26] discussed that the construction sector in Iraq did not implement the concept of sustainable construction, as the construction sector suffers from the dominance of conventional methods that negatively affect the environment and consume a lot of natural resources and unsustainable building materials that do not meet environmental and climatic requirements. While [10] argued that the construction sector in Iraq still uses materials and techniques that are not suitable for the local environment Iraq has not adopted any of the global sustainability assessment systems. [31] discussed that there is no system applied in construction projects in Iraq for waste management. The construction industry in Iraq faces serious difficulties in the form of construction waste generation and requires serious study to solve this problem. The percentage of construction and demolition waste for the year 2021 was 33.3% of the total waste raised by municipal institutions, which is a high percentage [14].

According to [14] The percentages of electric energy sales according to consumption categories for the year indicate that the domestic sector is the highest consumer of electricity in Iraq by a percentage of 60.70%, followed by commercial with 6%, industrial with 12%, governmental 12.40%, agricultural 1.60% and surpassing 7.20%. Figure 1 shows the Percentages of electric energy sales according to consumption categories for the year 2020. where the relative distribution of produced and distributed water for the year 2020 indicates that the domestic sector is the highest consumer of water, 84.6%, followed by the rest of the sectors with a percentage of 8.1%, then the government sector with a percentage of 7.3%. Figure 2 shows the percentage distribution of produced and distributed water for the year 2020.

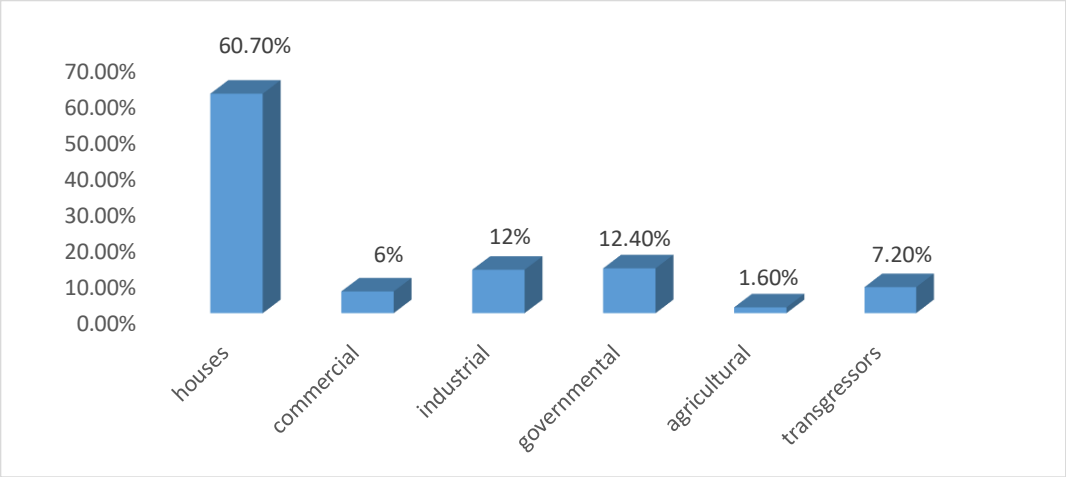

Figure 1. Percentages of electric energy sales according to consumption categories for the year 2020

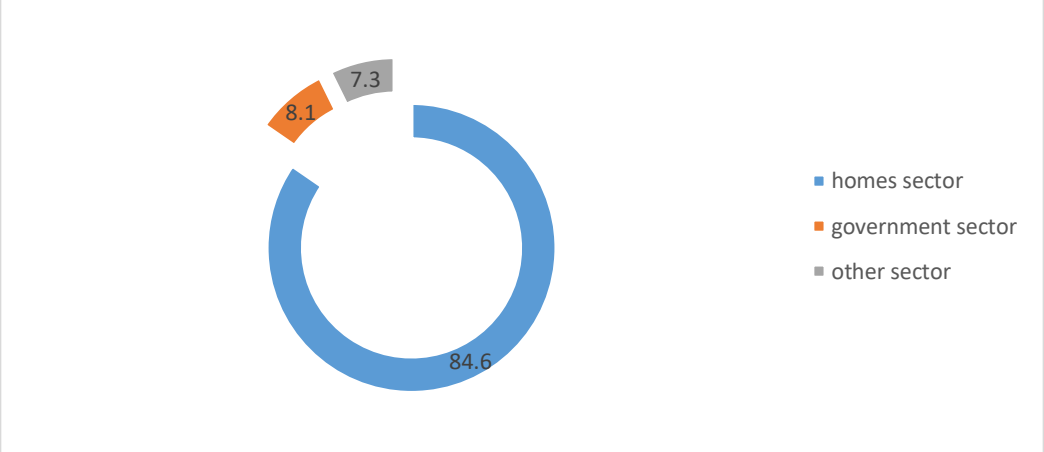

Figure 2. Percentage distribution of produced and distributed water for the year 2020

The focus of this study was on housing construction. Where according to the statistics of the Ministry of Planning, the construction of residential buildings constitutes the largest percentage in Iraq, as the construction of this type of buildings causes significant environmental pollution during their implementation. Government Statistics prove it show that homes are the largest consumers of energy and water and a major source of environmental pollution.

SUSTAINABLE CONSTRUCTION STRATEGIES

This study aimed to identify enabling strategies that can be adopted to achieve the transition towards sustainable housing construction in Iraq. These appropriate strategies for the transition to sustainable housing construction were identified by studying the relevant literature in addition to conducting interviews with expert engineers with experience in construction. Sustainable and green buildings. 15 credible strategies were identified, including institutional and technological empowerment strategies, and evaluation tools, in addition to financial support, incentives, and investment through which migration towards sustainable housing construction can be achieved. As shown in the explanation below:

Enhance the Awareness

[23] discussed that there is a need to educate and raise awareness of the community through conferences,

seminars, and all the media as it should. It also requires the seriousness of the goals and means for the success of any plan. [36], [46] and [29] discussed that enhancing awareness is an important enabler that supports the trend toward applying the sustainable building approach.

Incentives

Where [1] argued that the government should introduce more incentive-like schemes to attract developers and that information about incentives and discounts should be readily available to the public. Incentives and rebates are among several ways the government can act as a regulator to boost the industry. [33] discussed that the government needs to provide incentives to SC project owners as a means of encouraging others.

Investment

Creating the interest of investors, developers, and owners regarding the adoption of a sustainable building strategy that contributes to spreading the sustainable building approach in the construction industry, which results in the construction of residential buildings that meet environmental, economic, and social standards. [2] argued that it is necessary to alienate the client's fear of increasing the investment cost and create an appropriate for the benefits inherent in it.

Financial Support

Where [1] discussed that the financial institution usually engages with the industry in terms of providing a good financial scheme for buyers and builders as actions taken by the government to set up new regulations or rating systems are usually supported by professional bodies.

Enhance Sustainable Construction Training

Where [1] discussed that more local practitioners should be trained in knowledge and practical experience backed by more research on new green technology. While [21] discussed that training senior management and decision-makers to adopt a sustainable methodology and make it part of the company's traditions for the foreseeable future. [2] argued that improving sustainable construction and then changing from the base to adopting new ideas is necessary, in addition to that there is a need for appropriate enlightenment for clients and construction professionals about sustainable construction, and this can be achieved through Increasing the education and training of construction specialists on the principles and concepts of the sustainable construction. The concerned professional bodies can also assist by conducting training for their members in sustainable construction areas.

Develop Sustainable Construction Legislations and Regulations

About institutional enablers, [1] discussed that the government is one of the main institutions that has a significant impact on the development of any industry, as the government's role in improving and enforcing regulations related to sustainability leads to changes at the national level. These roles will drive construction players to research new technology, systems, and knowledge with government support. While [21] discussed that developing appropriate legislation and regulations is required to start the transition towards comprehensive sustainability. [33] discussed that building regulations and policies that will help in the development of sustainable buildings must be put in place.

Sustainable Construction Standards and Specifications

Where [1] discussed that Government, professional bodies and academia must work together to revisit existing standards and norms and incorporate sustainable needs.

Develop Sustainable Assessment Tools and Indicators

Standardization of KPIs and benchmarking programs that enforce sustainable construction practices is required so that construction companies are required to not only monitor practices but also to effectively compare with each other and set benchmarks for best practices. Key performance indicators related to measuring the potential social, environmental, and economic impacts of construction are critical to this approach. For example, social KPIs include passenger comfort, access to facilities, job creation, urbanization, etc.; While economic KPIs include cost of capital, running cost, material cost, etc.; Environmental KPIs target consumption of water, energy, waste, materials, and components [4]. [34] identified sustainability assessment as a driver of sustainable construction. The adoption of sustainability indicators and tools is one of the important strategies for measuring the sustainability performance of buildings. This calls for the adoption of international sustainability indicators, in addition to the development of national sustainability indicators that support progress in the sustainability of buildings. [29], [28] and [6] identified sustainability assessment as a driver of sustainable construction.

Develop Construction Waste Management and Recycling Facilities

[9] discussed strengthening and clarifying legislation so that the largest part of construction and demolition waste is reused or recycled in the construction sector through collaboration between regulators, legislators, researchers, and industry to develop a specific and feasible legal framework. [31] discussed that the authorities should design a waste management plan suitable for the implementation environment in Iraqi construction sites and develop a waste disposal data system due to the severe deficiency in the construction waste database at the local level. [17], [38] and [44] argued that developing construction waste management is an important enabler of sustainable construction.

Integrate the Sustainable Construction in the Education

[1] discussed that valuable knowledge obtained through (academic) research should be effectively disseminated to industry (to reduce the gap between theory and practical application). [2] argued that increasing the teaching of the concept of sustainability in higher education institutes is important to prepare construction graduates to be experts in sustainable construction. [34] and [15] mentioned that integrating sustainable construction in education is an enabler of sustainable construction.

Adopt Sustainable Buildings Design

The concept of sustainable design focuses on adopting new methods for design and construction that take into account the environmental and economic challenges faced by the construction sector and the rest of the sectors in society, as sustainable buildings that are designed, implemented, and operated by advanced methods and techniques contribute to reducing the environmental impact and reducing costs, especially operating and maintenance costs, in addition, in addition to providing a safe and comfortable urban environment. sustainable designs provide many benefits that include saving energy and water consumption, preserving the environment and improving the health and well-being of the occupants of these buildings. [15] and [39] identified sustainable design as an important strategy that promotes sustainable construction.

Enhance Sustainable Materials and Technology

The concept of sustainable building integrates a variety of strategies during the design, construction, and operation of construction projects. The use of green building materials and products is an important strategy in building design [26]. [13] argued sustainable construction takes into account the use of environmentally friendly materials that resist weather factors to preserve the building’s heat in winter and contribute to its

ventilation in summer, which reduces heat absorption. Double glazing also provides good insulation for the environment inside the building and the external environment, as well as the use of renewable energy such as solar and wind energy and the use of more systems. Efficiency of water as well as its reuse, thus helping sustainable or green buildings reduce energy consumption and reduce costs. Where [1] discussed that more local suppliers should be encouraged to produce green products. [43], [37] and [29] agreed that sustainable materials and technology enhance the sustainable construction approach.

Compulsory of Sustainable Construction

[47] argued that legislation that would compel clients to build sustainably should be created so that the economic needs and cost of sustainable construction become secondary to environmental sustainability. [21] discussed that the legislation and instructions accompanying the sustainable development movement in construction work must be supported. [38], [5] discussed that compulsory sustainable construction contributes to strengthening the implementation of the sustainable construction approach.

Develop Government Authorities Mechanisms

[32] discussed that achieving sustainability in the comprehensive construction process requires major societal changes and restructuring of institutions and management approaches. It requires appropriate political will based on the conviction of the government's responsibility towards its citizens and the need to create a humane and decent environment for decent living. While [21] discussed that the organizational structure must be updated and developed to keep pace with modern technologies on the Internet, which are fully compatible with the new organizational departments. [2] argued that the government needs to be actively involved in promoting sustainable construction by creating policies and providing the means to enforce them. In addition, the government can support sustainable construction by reviewing and enforcing legislation and policies and by introducing building codes. [33] discussed that the government must implement and monitor existing laws and regulations to deter defaulters. [28], [6], [38], [5], and [32] discussed that developing the government authorities' mechanisms is important in enhancing the implementation of a sustainable construction approach.

Support and Cooperate Stakeholders

The principles of sustainable building can be implemented smoothly and successfully when all stakeholders in the construction industry are involved, collaborative, and supportive, including government agencies, designers, owners, contractors, materials suppliers, manufacturers, and occupants of sustainable buildings. [18] discussed that sustainability in the construction sector can only be achieved through a partnership between society, government, and the sector. [34] identified cooperation, partnership, and participation as drivers of sustainable construction. [38], [5], [47], and [21] agreed that cooperation and support from all stakeholders as important to achieving the goals of sustainable construction.

RESEARCH METHODOLOGY

This study aims to achieve sustainable housing construction in Iraq to achieve the goal of this study, an in-depth review of the literature related to sustainable construction was conducted and a questionnaire was developed that includes two lists, the first related to demographic information, while the second list includes fifteen sustainable construction strategies that experts evaluate the effectiveness of these strategies by using a five-point Likert scale for three rounds. [11] stated that when planning an expert group, it is a good idea to think about potential stakeholder group analyses early in the process. To obtain reliable results taking into account statistical requirements, and suggest considering five aspects when composing a Delphi expert panel size of the panel, level of expertise, level of heterogeneity, level of interest, and access to the panel. The Delphi method was applied by sending the questionnaire independently to a committee of expert

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engineers with at least fifteen years of experience in the field of sustainable construction, to collect their various opinions. After the first and second rounds, the results were analyzed, the level of agreement between the experts was measured, and it was sent again to the experts, and the survey was completed after the third round, when achieving the highest level of agreement among the experts, the results were analyzed and the level of agreement was measured using the Kendall agreement coefficient by using SPSS.

Respondent's Demographic Background

This study aims to identify the sustainable construction strategies that support the transition to sustainable housing construction. To achieve the objectives of the study, a panel of a total of 14 expert engineers with extensive experience in sustainable construction and green buildings were targeted to be respondents to collect their opinions, observations, and recommendations. The process of collecting experts' opinions was done using the Delphi method. [12] stated that the number of participating experts in Delphi studies varies from 6-50 experts. In this study, the expert panel included project managers, consulting engineers, and design engineers. and execution engineers working on sustainable construction projects. Table 1 shows a summary of the demographic information of the respondents.

Table 1 Respondent's Demographic Background

Respondent's Demographic Background				
Academic Background	Bachelor Degree		10	
	Master Degree		4	
Sector Type	Developer		2	
	Consultants		7	
	Contracting		5	
Job Designation	Project Manager	3	Civil Engineer	5
	Resident Engineer	1	Mechanical Engineer	1
	Designer/Architect	2	Electrical Engineer	2
Total Experience in the Construction Sector	15 – 20 Years		11	
	20 – 29 Years		2	
	30 + Years		1	

RESULTS ANALYSIS

Results of Delphi Round One

Examining the results of the Delphi round, one reveals that all the strategies were considered significant, where the mean score of each strategy was higher than 3.0, therefore all the strategies have been selected for the next Delphi round. Thirteen parameters resulting from Delphi round one obtained Likert point mean values above 4. These strategies were to enhance the awareness, incentives, investment, and financial support, enhance sustainable construction training, develop sustainable construction legislation and regulations, sustainable construction standards and specifications, develop sustainable assessment tools and indicators, develop construction waste management and Recycling Facilities, Integrate the Sustainable Construction in the Education, Adopt Sustainable Buildings Design, Enhance Sustainable Materials and Technology and Develop Government Authorities Mechanisms. The remaining two strategies include compulsory sustainable construction and support and cooperating stakeholders achieved Likert point mean values above 3.00. Table 2 shows the results of the Delphi round one.

Table. 2 Results of the Delphi Round One

Code	Parameters	Rank	Likert Point Mean	Mean Rank	Std. Deviation
P1	Enhance the Awareness	3	4.43	9.5	0.514
P2	Incentives	5	4.14	7.43	0.363
P3	Investment	6	4.07	7.00	0.616
P4	Financial Support	6	4.07	6.89	0.267
P5	Enhance Sustainable Construction Training	5	4.14	7.43	0.363
P6	Develop Sustainable Construction Legislation and Regulations	1	4.93	13.07	0.267
P7	Sustainable Construction Standards and Specifications	2	4.57	10.61	0.514
P8	Develop Sustainable Assessment Tools and Indicators	5	4.14	7.43	0.363
P9	Develop Construction Waste Management and Recycling Facilities	4	4.21	7.96	0.426
P10	Integrate the Sustainable Construction in the Education	7	4.00	6.36	0.000
P11	Adopt Sustainable Buildings Design	2	4.57	10.64	0.646
P12	Enhance Sustainable Materials and Technology	6	4.07	6.89	0.267
P13	Compulsory of Sustainable Construction	9	3.86	5.5	0.535
P14	Develop Government Authorities Mechanisms	5	4.14	7.39	0.363
P15	Support and Cooperate Stakeholders	8	3.93	5.89	0.267
	Number of parameters	15			
	No. of respondents	14			
	Kendall's Coefficient of Concordance	0.360			

Results of Delphi Round Two

Examining the results from Delphi round two shows that all strategies obtained Likert point mean values above 4 except the strategy compulsory of sustainable construction achieved Likert point mean values above 3.00 with 3.93. It was noticed that the level of consistency among the participating experts increased from 0.360 in the first round to 0.434 in the second round. The results of the second round of Delphi indicate that the strategy, of developing sustainable construction legislation and regulations was ranked first, and it achieved a Likert point mean value (Lvi) of 4.93, while the strategy of sustainable construction standards and specifications ranked second with a Likert point mean value (Lvi) of 4.71, while the strategy Adopt Sustainable Buildings Design ranked third with a Likert point mean value (Lvi) of 4.64, the strategy Enhance the ranked fourth with a Likert point mean value (Lvi) of 4.43, while the strategy Compulsory of Sustainable Construction gained a Likert point mean value (Lvi) of 3.93 and was ranked last. Results from Delphi round two showed that all the parameters were considered significant, where the mean score of each

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parameter was higher than 3.0 therefore, all the parameters have been selected for the next Delphi round. Table. 3 shows the results of the Delphi round two.

Table. 3 Results of the Delphi Round Two

Code	Parameters	Rank	Likert Point Mean	Mean Rank	Std. Deviation	
P1	Enhance the Awareness	4	4.43	9.43	0.514	
P2	Incentives	6	4.14	7.29	0.363	
P3	Investment	8	4.00	6.25	0.392	
P4	Financial Support	7	4.07	6.75	0.267	
P5	Enhance Sustainable Construction Training	6	4.14	7.29	0.363	
P6	Develop Sustainable Construction Legislation and Regulations	1	4.93	13.07	0.267	
P7	Sustainable Construction Standards and Specifications	2	4.71	11.54	0.469	
P8	Develop Sustainable Assessment Tools and Indicators	6	4.14	7.29	0.363	
P9	Develop Construction Waste Management and Recycling Facilities	5	4.21	7.82	0.426	
P10	Integrate the Sustainable Construction in the Education	8	4.00	6.21	0.000	
P11	Adopt Sustainable Buildings Design	3	4.64	11.04	0.497	
P12	Enhance Sustainable Materials and Technology	7	4.07	6.75	0.267	
P13	Compulsory of Sustainable Construction	9	3.93	5.82	0.475	
P14	Develop Government Authorities Mechanisms	6	4.14	7.25	0.363	
P15	Support and Cooperate Stakeholders	8	4.00	6.21	0.000	
	Number of parameters	15				
	No. of respondents	14				
	Kendall's Coefficient of Concordance	0.434				

Results of Delphi Round Three

Results from Delphi round three showed that all strategies were considered significant, where, obtained Likert point mean values above 4 except the strategy compulsory of sustainable construction achieved Likert point mean values above 3.00 which is equal to 3.93. It was noticed that the level of consistency among the participating experts increased from 0.434 in the first round to 0.572 in the third round. The results of the third round of Delphi indicate that experts agreed that the strategy develop sustainable construction legislation and regulations is the most important as it ranked first with achieving of Likert point mean value (Lvi) of 4.93, while two strategies include Sustainable Construction Standards and Specifications and Adopt Sustainable Buildings Design ranked second with a Likert point mean value (Lvi) of 4.86, while the strategy Enhance the Awareness sustainable ranked third with a Likert point mean value (Lvi) of 4.43, the strategies Incentives and Develop Government Authorities Mechanisms ranked fourth with a Likert point mean value (Lvi) of 4.14, while the strategy Compulsory of Sustainable Construction

funding sustainable research gained a Likert point mean value (Lvi) of 3.93 and was ranked last. Table 4 shows the results of the Delphi round two.

Table. 4 Results of the Delphi Round Three

Code	Parameters	Rank	Likert Point Mean	Mean Rank	Std. Deviation
P1	Enhance the Awareness	3	4.43	9.36	0.514
P2	Incentives	4	4.14	7.21	0.363
P3	Investment	6	4.00	6.25	0.392
P4	Financial Support	5	4.07	6.68	0.267
P5	Enhance Sustainable Construction Training	4	4.14	7.21	0.363
P6	Develop Sustainable Construction Legislation and Regulations	1	4.93	13.04	0.267
P7	Sustainable Construction Standards and Specifications	2	4.86	12.5	0.363
P8	Develop Sustainable Assessment Tools and Indicators	5	4.07	6.68	0.267
P9	Develop Construction Waste Management and Recycling Facilities	5	4.07	6.68	0.267
P10	Integrate the Sustainable Construction in the Education	6	4.00	6.14	0.000
P11	Adopt Sustainable Buildings Design	2	4.86	12.54	0.363
P12	Enhance Sustainable Materials and Technology	5	4.07	6.68	0.267
P13	Compulsory of Sustainable Construction	7	3.93	5.71	0.267
P14	Develop Government Authorities Mechanisms	4	4.14	7.18	0.363
P15	Support and Cooperate Stakeholders	6	4.00	6.14	0.000
	Number of parameters	15			
	No. of respondents	14			
	Kendall's Coefficient of Concordance	0.572			

RESULTS DISCUSSION

The results of three Delphi rounds indicate that the experts have re-evaluated the effectiveness of the 15 strategies, and a convergence in their opinions has been noted. The analysis of the results of the third round of Delphi indicates that there has been a convergence of opinions among the responding experts, as Kendall's examination of consistency showed an increase in the level of consistency among them from 0.434 in the second round to 0.572 in the third round according to Kendall's scale. The degree of agreement between experts was measured using Kendall's coefficient of concordance, where the range is (0-1). [19] stated that the range of Kendall's coefficient of concordance W (0-1), where W=0 indicates the absence of agreement, while when W=1 indicates complete agreement or unanimity Table 5 shows a Comparison between the results of Kendall's Coefficient of Concordance (W) in Delphi round two and round three. Table .5 shows the comparison between the results of Kendall's Coefficient of Concordance (W) in round

two with round three.

Table .5 Comparison between the results of Kendall's Coefficient of Concordance (W) Round Two with Round Three

Kendall coefficient of concordance (W)	**Round 2**	**Round 3**
Level of agreement among participants	0.434	0.572

Comparing the results between the second and third rounds of the Delphi survey shows the stability of the ranking of 3 strategies including developing sustainable construction legislation and regulations, sustainable construction standards and specifications, and developing construction waste management and recycling facilities with a slight change in the classification of the rest of the strategies. Table 6 shows a comparison between ranks from Delphi rounds two and three.

Table. 5 Comparison between Ranks from Delphi Rounds Two and Three

Code	**Parameters**	**Rank Delphi Round Two**	**Rank Delphi Round Three**
E1	Enhance the Awareness	4	3
E2	Incentives	6	4
E3	Investment	8	6
E4	Financial Support	7	5
E5	Enhance Sustainable Construction Training	6	4
E6	Develop Sustainable Construction Legislation and Regulations	1	1
E7	Sustainable Construction Standards and Specifications	2	2
E8	Develop Sustainable Assessment Tools and Indicators	6	5
E9	Develop Construction Waste Management and Recycling Facilities	5	5
E10	Integrate the Sustainable Construction in the Education	8	6
E11	Adopt Sustainable Buildings Design	3	2
E12	Enhance Sustainable Materials and Technology	7	5
E13	Compulsory of Sustainable Construction	9	7
E14	Develop Government Authorities Mechanisms	6	4
E15	Support and Cooperate Stakeholders	8	6

The results of the study revealed that experts agreed on all the strategies that were identified and measured through the use of the specified criteria for the Delphi approach and the validity of the 15 sustainable strategies in adopting and implementing sustainable construction practices in the Construction industry. Figure 3 shows the scoring of 15 sustainable construction strategies which is obtained from Delphi round three.

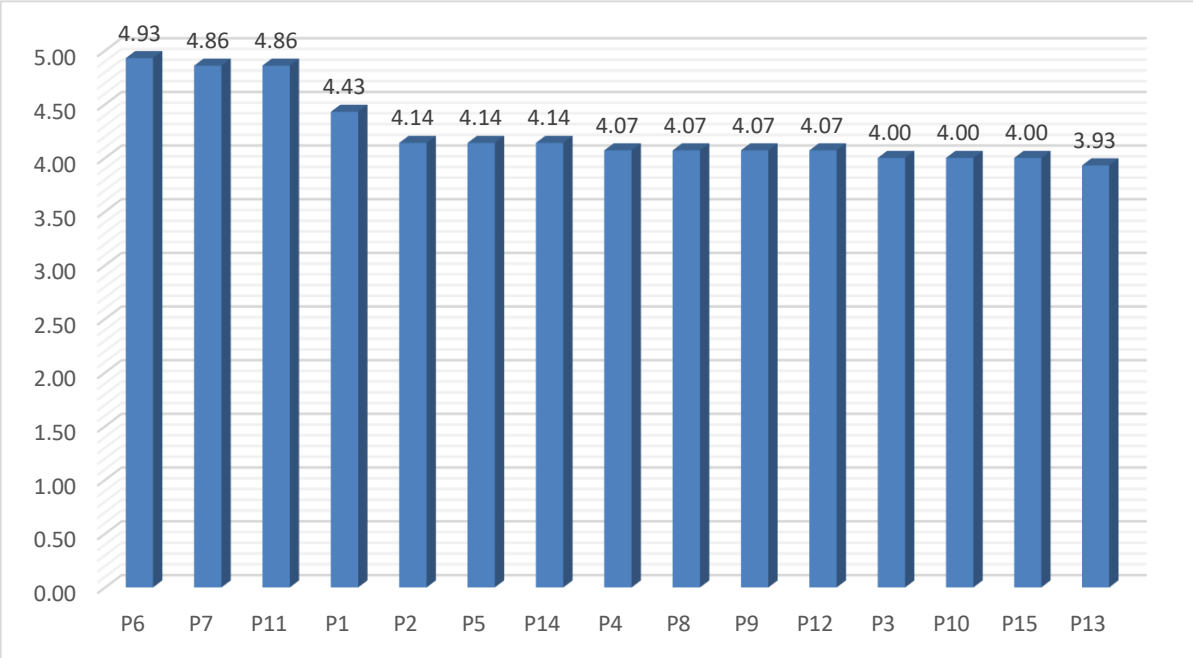

Figure 3 Institutional Strategies Delphi Round Three

The current situation of the construction industry in Iraq requires a sustainable road map to develop sustainable construction practices adopting a sustainable approach and achieving the transition towards sustainable housing construction. Whereas, in this study, sustainable strategies were identified, through which they can be adopted to achieve the transition toward the establishment of sustainable housing. These strategies included enhance the awareness, incentives , encouraging investment in the sustainable construction projects, financial support, develop sustainable construction legislations and regulations, sustainable construction standards and specifications, develop sustainable assessment tools and indicators, develop construction waste management and recycling facilities, Integrate the sustainable construction in the education enhance sustainable construction training to building sustainable capabilities that support sustainable implementation and enhancing the sustainable performance, adopt sustainable buildings design, enhance sustainable materials and technology, compulsory of sustainable construction, develop government authorities mechanism and making them able to lead the process of transformation towards a sustainable building approach through sustainable and advanced methods in terms of management, supervision, control and monitoring and support cooperate stakeholders at all stages of construction starting From planning, design, construction and operation to the demolition stage. Figure 5 shows sustainable construction strategies.

CONCLUSION

Continuing to adopt the conventional construction approach prevailing in the construction of housing in Iraq is currently an approach that does not meet the environmental, economic, and social requirements in Iraq because of the large consumption of energy and water, environmental pollution, and deterioration resulting from construction work and consumption of resources. Therefore, the shift towards sustainable construction in the construction industry in Iraq contributes It greatly contributes to a development that works to reduce the consumption of resources, energy, and water, and enhances the preservation of the environment through the development of sustainable performance for all stakeholders and the dissemination of sustainable culture in the construction industry. and rising energy prices. This study focused on the construction of housing, as this type of building constitutes the largest percentage compared to commercial and industrial buildings, where the construction of residential buildings causes significant environmental pollution during

implementation, as it is done in the traditional way in which environmental standards are not taken into account, and the long-term use of these buildings It causes more energy and water consumption. The study revealed the current situation of the building and construction industry in Iraq, and several strategies were identified that can be applied it will contribute effectively to adopting a sustainable housing construction approach in the construction sector in Iraq. The shift towards building sustainable housing in Iraq will lead to beneficial results, including achieving sustainability in the construction sector, in addition to contributing to the sustainability of other sectors, including the energy and water sector, in addition to reducing pollution, protecting the environment and promoting sustainable development plans, In addition to providing suitable sustainable housing for the population, providing comfort and well-being, improving indoor air quality, and improving health. The results of this study are important for policymakers and stakeholders in the construction industry in Iraq because it provide a strategy for shifting towards sustainable housing construction that can be a roadmap for migration towards sustainable construction in a country that has not adopted sustainable construction.

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