Basmaya Residential Complex compatibility with the Iraqi Green Architecture Code

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Abstract:

The increase in the Iraqi population put pressure on urban cities as there were no new cities built since the 1980s due to the wars and the economic blockade imposed in 1991 and the deteriorating security situation after 2003, where the population in 2018 reached about forty million people. Iraq also suffered during the past decades from problems and challenges in many respects that affected the local environment, and the constructed buildings had a role in increasing these impacts, so the Ministry of Housing worked to issue the Iraqi Green Architecture Code in 2019 to reduce damage to the environment and use resources more efficiently. And because the constructed buildings were not constructed according to green standards, including Basmaya residential complex, so the problem of the research came as (finding out the compatibility of Basmaya residential complex with the Iraqi Green Architecture Code), and the aim of the research is (to try to get Basmaya residential complex to one of the levels of the code and upgrade it). The research showed that Basmaya residential complex obtained the level of one star from the levels of the Iraqi Green Architecture Code, and the researcher suggested several treatments for the buildings to upgrade them to the level of three stars.

1. Introduction:

When the energy crisis occurred in the 1970s of the twentieth century, the need for buildings that reduce energy consumption and depend on renewable energy emerged, so designers researched and developed buildings and homes that use solar energy and

considered them environmentally friendly, but they were few due to the high initial costs. After nearly two decades in the nineties, with the growing problem of global warming and climate change, global agreements were concluded between countries to develop solutions in order to reduce environmental problems. The construction sector had great contribution in reducing environmental problems especially that 40% of CO2 emissions are caused by energy consumption in buildings [1]. Therefore, there had been a trend towards energy-efficient buildings, including green buildings, which were defined by the World Green Building Council as a building that is designed, built or operated in a way that reduces or eliminates the negative impacts of the environment, and can create positive impacts on the climate and the natural environment, and preserve resources and improve the quality of our life [2]. Then developed countries began to seek to establish green rating systems for new buildings. The first of these countries was Britain, which created the BREEM system, and then America, which created the LEED system. After several years, other countries created their own rating systems. This also obliged Iraq to proceed in the same way by creating its own system for evaluating green buildings. The Iraqi Green Architecture Code was issued by the Ministry of Housing in cooperation with the Central Organization for Standardization and Quality Control of the Ministry of Planning.

2.The Iraqi Green Architecture Code (Green Rivers)

The Code: It is a set of rules related to a specific topic, or an organized group of legislations that may be legal, engineering or both. Such a group must be organized and categorized in such a way that avoids inconsistency and overlapping between its paragraphs and clauses [3].

The project of building codes and technical specifications for the Iraqi construction work and the application of the unified Iraqi codes was initiated in 2009 under the name (preparing, developing and improving the specifications and legislation of the building codes in Iraq). It includes the preparation of 43 building codes and technical specifications for the Iraqi construction works, in which more than 440 scientific experts and university professors participated.

In 2019, The Ministry of Housing and Construction in Iraq developed the Green Rivers Rating System which aims to introduce the principles, concepts and applications of green architecture appropriate to the local environmental aspects of the Iraq climate, and includes all stages related to planning, design, operation, construction, use, works, site study, maintenance, rehabilitation and recycling of building components. Taking into consideration the requirements of energy and water conservation, and achieving the

quality of the indoor environment and building systems with effective building management [4].

This system rating process is divided into seven levels, as the total of the points that have the basic requirement (mandatory requirements) represent the lowest level, which is the licensed, and after that the levels are graded with the number of stars for each level that contains a number of points required according to table (1):

Table (1) The rating levels of the different types of buildings in the Code and the number of points required [5]

Leve	Residential Bui		Comm	I	Educa	G
	Individ	Com				
Six s	104	116	110	1	110	11
Five	100	106	101	1	101	10
Four	90	96	91	9	91	91
Thre	80	86	81	8	81	81
Two	70	76	71	7	71	71
One	60	66	61	6	61	61
Lice	40	59	54	5	54	54

We find in table (1) that the required individual residential building points (40) are different from the required points of the residential building for the complexes (59), while the rest of the buildings share the same number of the required points, which are (54). A higher level can be obtained by adding approximately 10 points to each level.

As for the points collection form for the categories and their requirements, they are explained in Appendix (1).

3. The housing crisis in Iraq:

The increase in the Iraqi population put pressure on urban cities as there were no new cities built since the 1980s due to the wars and the economic blockade imposed in 1991 and the deteriorating security situation after 2003, where the population in 2018 reached about forty million people, according to [6].

It turns out that there is a housing crisis of 5 million housing units with their service buildings, and this contributed to displacement and unorganized migration from peripheral areas to urban city centers, especially Baghdad, Basra and Erbil. Therefore, the Iraqi government sought to establish special peripheral cities in Baghdad, and among them was Basmaya, which construction started in 2013, and continues to the moment. A similar city could be established in the outskirts of Basra Governorate

. Therefore, the research problem came as an attempt to find out the compatibility of the Basmaya residential complex with the Iraqi Green Architecture Code, since it appeared in 2019, that is, six years after the implementation of the Basmaya residential complex. As for the aim of the research, it is an attempt to get Basmaya residential complex to one of the levels of the Code and upgrade it.
The research methodology used for each requirement is explained in Appendix (1)

4. Basmaya Residential Complex (New City Project)

Figure (1) An aerial view showing the sectors of the city of Basmaya [7]
A briefing about Basmaya Project: It is a residential city project located within the governorate of Baghdad, implemented by the Korean Hanwha Company. The Basmaya new city project is considered the first and the largest project in the history of Iraq. Basmaya is located in the southeast of the capital, Baghdad, and is about 10 km from the borders of Baghdad on the international road linking Baghdad with Al-Kout. It has an area of 1,830 hectares (18,300 square kilometers) and is designed to accommodate about 600,000 people with 100,000 housing units. A network of infrastructure of main streets, electricity and water will be established, in addition to public and service facilities that the Iraqi government will develop, including commercial, religious, recreational and educational facilities, as well as sewage and water treatment plants. The new city of Basmaya will be one of the most modern cities in Iraq and the first giant project. The implementation started from 2013

and continues to the moment [8]. Basmaya residential complex has been chosen for being the most recent housing project in Iraq that has been built recently.
Basmaya residential project consists of eight sectors and each sector is divided into several blocks that contain a number of housing units in buildings with (10) floors, each floor contains (12) apartments [9] as shown in the table and figure (2):
Table (2) The sectors and the number of blocks and housing units of Basmaya city (Prepared by the researcher)

S.	Sector	Number of blocks	Housing units of each sector
1	A	A1, A2, A3, A4, A5, A6, A7, A8, A9	14.280 Units
2	B	B 1, B 2, B 3, B 4, B 5, B 6, B 7, B 8	15.240 Units
3	C	C 1, C 2, C 3, C 4, C 5, C 6	10.200 Units
4	D	D 1, D 2, D 3, D 4, D 5	9.480 Units
5	E	E 1, E 2, E 3, E 4, E 5, E 6, E 7, E 8, E 9	13.920 Units
6	F	F 1, F 2, F 3, F 4, F 5, F 6, F 7, F 8	13.440 Units
7	G	G 1, G 2, G 3, G 4, G 5, G 6	10.920 Units
8	H	H 1, H 2, H 3, H 4, H 5, H 6, H 7, H 8, H 9	12.600 Units
Total	**8**	**60 blocks**	**100.000 Units**

Figure (2) illustrates the zoning of Basmaya city, where green color refers to open spaces, green and blue for educational areas, gray for the middle of residential blocks, red for markets, and yellow will be a commercial, entertainment and religious center for the city.

Figure (3,2) Zoning of Basmaya city, the blocks and shops in the sectors of Basmaya city [10]

All completed buildings were equipped with a system of services including water, electricity, gas and communication networks, with the use of thermal insulation technology which was adopted in precast concrete. The outer yard of each building contains a yard dedicated for parking.

Each single building contains (120) housing units of (traditional / modern style) distributed between three areas (140 m², 120 m² and 100 m²) within ten floors, each floor includes (12) housing units, with two central elevators available [11].

Figure (4) Horizontal plan of the residential apartments in a single building [11]

The apartment of 100 m² and 120 m² (traditional / modern style), includes a living room, kitchen and master bedroom with two other bedrooms, in addition to other services. While the apartment of 140 m² (traditional / modern style) contains a living room, kitchen and master bedroom with three other bedrooms as shown in the following plans:

Figure (5) apartment plans (100,120,140) m² for the eastern style [11]

Figure (6) Apartment plans (100,120,140) m² for western style [11]

The practical application will be on Sector (A) only for the completion of construction and housing in it, while Sector (B) is still under construction and 70% of it has been completed, and Sector (C) the foundations have been completed and Sector (D) the infrastructure has been completed, upon preparing this research

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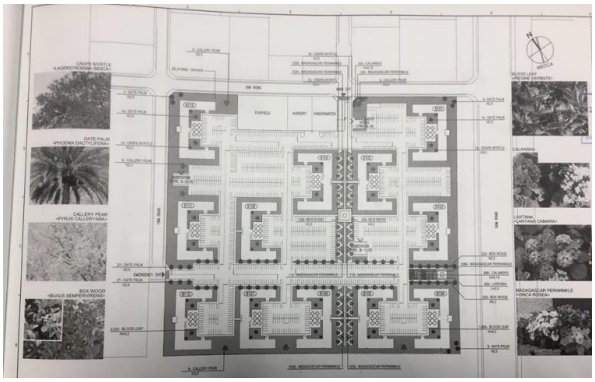
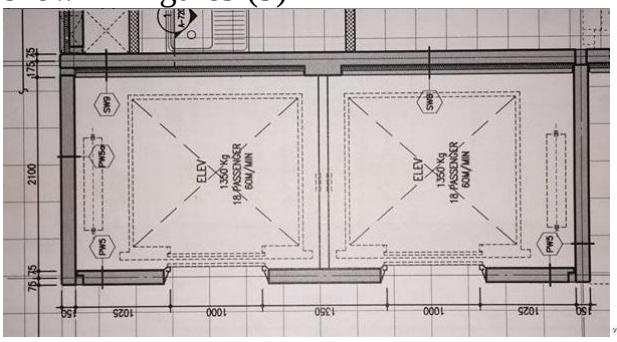
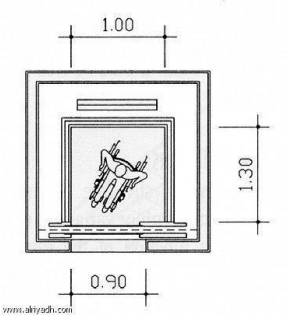
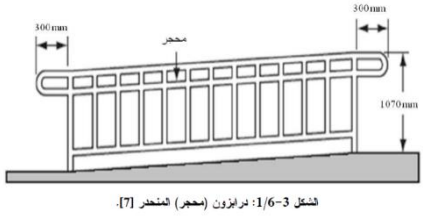
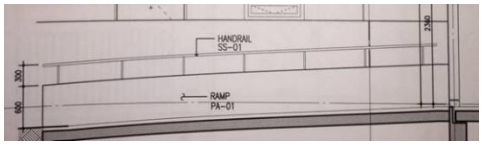
Basmaya Complex compatibility with the Green Architecture Code:

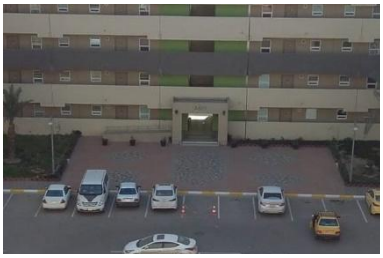
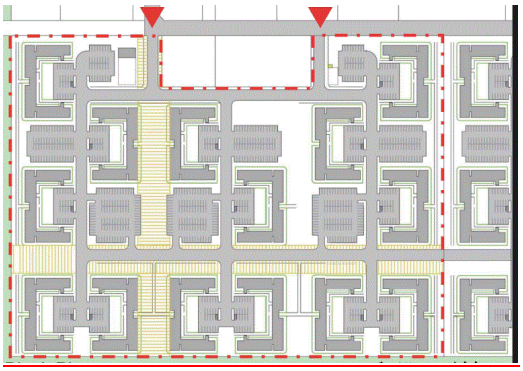
After illustrating the city of Basmaya, the compatibility of Basmaya residential complex will be determined according to the requirements of the Iraqi Green Architecture Code for all categories of the code, and the requirements that have been achieved will be marked as (✓) and those which have not been achieved will be marked as (✕).

Note: The symbol (*) indicates that the requirement is essential for green buildings.

Table (3) The application of the theoretical framework for site selection of Basmaya complex (prepared by the researcher)

S	Site Selection Section Requirement	Achie	Point
1 S *	**Away from urban centers**: Basmaya is about 10 km away from the Baghdad b which reduces The overpopulation of Baghdad, and 25 km from the city center of Baghdad [7].	✓	2
2 S *	**Protection of agricultural sites and natural reserves**: According to the environ report of the National Investment Authority, the area is non-agricultural [12].	✓	1
3 S *	**Preserving heritage sites**: According to the environmental report of the N Investment Authority, There is no heritage buildings in the area [12].	✓	1
4 S	**Interconnection with urban neighborhoods**: The city of Basmaya is divided into eight sectors (A, B, C, D, E, F, G, and H) and the following figure shows the types of roads in it:  Figure (7) Roads in Basmaya [10] The distance from one street to another, according to sections, is 330 meters.	✓	1
5 S	**Dealing with the topography of the site**: According to the environmental report National Investment Authority, the site of Basmaya is located in the alluvial plain, which is area, and no major change has been made to it since it is not mountainous or the site of marsh lakes [13].	✓	1
6 S	**Infrastructure**: The city of Basmaya has been built according to the plans whicl provided, and There was no change in the functional pattern or the change of construction from ver	✓	1

	horizontal. The depth of the infrastructure for water and electricity services is 10 feet undergro avoid the Presence of electricity wires in the city. The number of residents allocated is 6 peo each Apartment (100 thousand apartments to accommodate 600,000 people, according report of the National Investment Authority) [14].		
7 S	**Afforestation**: All sidewalks and median strips were planted, and the types of trees used were date palms, aromatic trees, Madagascar periwinkle, pear, and Gomphrena globosa. Figure (8) Trees used in a residential neighborhood in Basmaya [13] 	✓	1
8 S *	**Empowering people with disabilities**: 10% of parking areas were provided for peop disabilities. As for dealing with building facilities and entrances, elevators were provide dimensions suitable for people with disabilities, as indicated by the Code of Iraqi People with disabili shown in figure9 (9)   Figure (9) The elevator dimensions as required by the code of Iraqi People with disa and an elevator in a residential building in Basmaya [13]  الشكل 3-1/6: درابزون (محجر) المنحدر [7].  Figure (10) Dimensions of the entry slope of a building in Basmaya residential buildin And the dimensions of the slope as required by the Code of Iraqi People with disabili	✓	1

9 S *	**Encouraging bicycles**: There are no roads within the plans of Bismayah complex to encourage the use of bicycle, but condition (A) was provided to make available areas for bicycles parking in a place less than 30 meters away from the entrance to the building and within the boundaries of the building land by Residents of Basmaya themselves.  Figure (11) the bicycles parking area (photo by the researcher)	✓	1
10 S *	**Ease of access to the site**: The requirement (a) is achieved through the presence of paved roads leading to the building site, as well as the paved building entrance, and the requirement (b) is achieved by providing a ramp to enter the building as shown in the following figure:  Figure (12) The paved slope and pavement to enter the building.(Photo by the researcher)	✓	1
11 S *	**Car parks**: A car park has been allocated for each apartment, where there are two parking areas in Basmaya, a central parking lot for the city located in the middle and another parking for each sector, and the number of car parks in A1-BLOCK is 1175 car parks, i.e. a ratio of 0.82 for A1 apartments- and the rest of the parking areas are in the central parking lot of the city [13]  Figure (13) The car park for each neighborhood [13]	✓	1
12 S *	**Open and green areas**: the construction coverage rate for the land in Sector A was 1 meaning That the remaining is 84.04% and the required percentage is 30%, so the requirer achieved.	✓	1
13 S	**Reducing the impact of urban thermal islands**: Requirement (b) was provided by shading paths and sidewalks with trees and roofs, as in the pictures below, where the sheds and trees are in the growing Stage.  Figure (14) Presence of trees in the growing stage (Photo by the researcher)	✓	1
14	**Shading sidewalks and roofs**: Requirement (b) was provided by using light colors ceilings with	✓	1

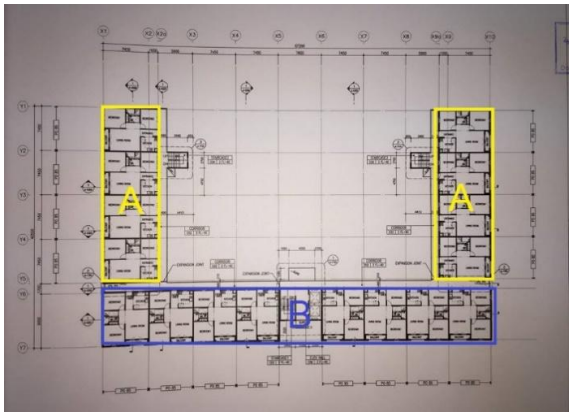
S	the value of the solar reflectance index more than (78) and this value is determi LEED and Global and that the value of solar reflection is written on the used dye which is plastic and the Value of the solar reflection is (82).		
15 S *	**Noise pollution**: According to the Iraqi Code of Acoustics, the acceptable level of n the outdoor environment at night is (45) db. The noise was measured by applyin METER) from outside the Residential building and the result was (41) db, which is within the acceptable level. the acceptable noise level in the daytime for the outdoor environment, it is (50-55) db, a result was (48) db, which is within the acceptable level. We find the lack of noise pollution due absence of a nearby airport and train station, as well as the few number of residents, as there number of empty apartments that have been purchased but are not currently accommo	✓	1

Table (4) shows the achieved values for Basmaya Residential Project according to the Energy Conservation Section in the Code (prepared by the researcher)

S.	Energy Section / Requirement	A.	P.
1E	**Coordinating the location of the building:** one of the facades cannot be planted with climbing plants, Nor can trees be planted equivalent to the height of the wall of a residential building of 29.950 mm. And the trees used are the date palm with a height of 2 meters, the basil tree with a height of 2.5 meters, the pear tree with a height of 2 meters and the following table sho height of the trees used: Table (4 / a) Trees height in Basmaya [13]	✕	3
2E	**The building shape:** the single residential building is divided into three parts in the form of letter (U). Therefore, the outside area will be calculated for each part separately and compared to the shape of a Cube of the same size (reference building). Part (A) is repeated so one part will be calculated and part (B) will be calculated according to the equation shown in Appendix (1) within the energy, the second requirement and the rates were as follows: S	✓	1

TREE QUANTITY TABLE

	SYMBOL	NAME	UNITS	SIZE	QUANTITY
TREE		CRAPE MYRTLE	EA	H=2.5	32
		CRAPE MYRTLE	EA	H=2.0	24
		DATE PALM	EA	H=2.5	63
		DATE PALM	EA	H=2.0	24
		CALLERY PEAR	EA	H=2.0	21
TOTAL			EA		164



	FACTOR (A) = 1.3,SHAPE FACTOR (B) = 1.5 Figure (15) The Three Parts of a Residential Building [13] The required rate and 1.5, so the value is achieved in part (B) and in part (A).		
3E	**Cases** of building block formation: Not required for residential complexes, o individual buildings.	-	-
4E	**Building mass direction**: Buildings are not defined by a specific direction, a building has a different direction from the other.	✕	**1**
5E	Burying the building mass in the ground: There are no buildings in Basmaya underground completely or 50% of underground, and it is not possible to bury them.	✕	**7**
6E*	Thermal insulation of the building envelope \ walls: The wall units of Ba buildings are manufactured in two factories, the first is sandwich wall plant, in which concrete panels Are made to insulate heat by applying Styrofoam to thermal insulation building from the external conditions in the summer and to preserve heat in the inside the residential unit. Its thermal insulation ranges from 0.03 to 0.034, which is equivalent to the insulation va W12 walls in the Green Architecture Code [16]. As for The second factory is Battery wall pl which partitions are Made to separate the spaces inside the residential unit. [15]	✓	**7**
7E*	**Thermal insulation of the building envelope / roofs:** The roof and floor ur manufactured in the Hollow Core Slab Plant, pre-manufactured concrete pieces that are toug lightweight as they are hollow to pass supplies and provide thermal insulation which value is rangin 0.032 to 0.039, Which is equivalent to the insulation value of C11, which is what the greer requires. [16]	✓	**3**
8E	**Shading the building facades**: In front of all windows, there is a protrusion of the corridor by 1.2 Meters, that is, more than a meter. As for the balcony, it reaches 1 meter. Figure (16) a horizontal view of a building in Basmaya that shows the corridor and the balcony [13]	✓	**1**

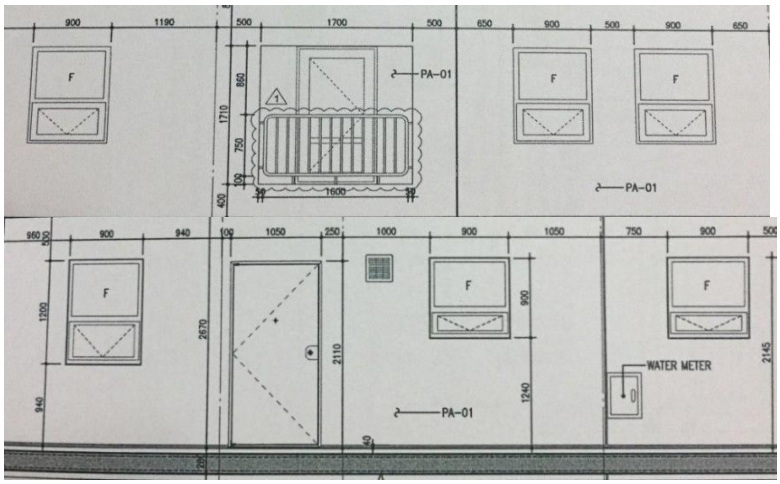
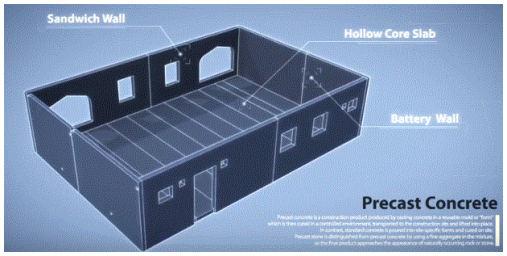
9E*	**The window opening space to the facade**: The dimensions of the windows used in the residential buildings of Basmaya Complex are as follows:  Figure (17) Dimensions of windows used in Basmaya residential buildings [13]. The ratio of windows to walls was 0.7, which is less than 20%, so the requirer achieved.	✓	6
10E	**The effect of the type of windows on energy saving:** the glass used is single a double.	✕	1
11E	**Window shape**: the windows used in different dimensions 900 * 1200 mm - 900 mm - 1700 * 900 mm – square for the bathroom 500 * 500 mm, the windo longitudinal and not transverse, and it is not Possible to change the shape of the windows as the building is prefabricated. [1	✕	1
12E	**Installing windows**: windows are installed in the middle of the wall of the spa it is possible to Change the location of its installation to the inner edge of the space.	✕	1
13E	**Solar cells, wind energy or innovative energies:** Solar cells were not used to residential buildings in Basmaya city, only in Basmaya tower 80% of the solar energy wa to supply The tower [16].	✕	5
14E	**Solar Heater**: No solar heater was used.	✕	4

Table (5) Application of the theoretical framework for water conservation strategies (Prepared by the researcher)

S.	Water Section / Requirement	A.	P.
1Wa	Conservation of drinking water consumption in buildings: The equipme bathrooms and kitchens required by the Green Architecture Code descri Appendix (1) were not used.	✕	5
2Wa*	Conservation of water consumption in the irrigation of plants: The met spraying was used in The public gardens of the complex, and not the method of surface drip.	✕	4
3Wa	Providing a gray water filtration and cleaning system. The use of gray w irrigation or domestic operations: An advanced plant was established with H	✓	4

	technology, which filters and treats Sewage and rain water by applying ultraviolet (U.V.) on the water to k bacteria in it [15].		

Table (6) Application of the theoretical framework for strategies to conserve the building systems and building materials (prepared by the researcher)

S.	Building systems and materials Section Requirement	A.	P.
1S*	**Efficiency of choosing the structural system**: The prefabricated building (PRECAST UNITES) was adopted, which significantly reduces the percentage of damage and loss in building materials compared to other types of construction, by using eight structural pieces with a floor as shown in the following figure:  Figure (18) Prefabricated pieces for installing an apartment	✓	2
2S	**Determining the functional program:** The areas of apartments are 100/120/140 m^2, and according to the planning standards of the Ministry of Housing, Basmaya apartments occupy the average area for a single family residence as shown in the following table (6 / a): The areas of the apartments required in the broch urban housing standards Table (6/a) That is, within the areas required by housing standards [17]. The space for multiple housing / The housing unit category 57-63 / 1 / SMALL 75-69 / 2 93-99 / 1 / Medium 108-114 / 2 138-147 / 1 / big	✓	1
3S	**Simplicity in design and implementation**: a square engineering network was u the design of the units without any engineering complications according to frequent distances, makes the implementation process easier, faster and with better quality and less bu materials, as shown in Figure (4).	✓	1
4S	**Modularity and standardization**: prefabrication has been adopted that reduc use of materials and The implementation in the shortest period of time. The materials used in the fi such as flooring And bathroom ceramics, were also chosen by Hanwha company to reduce bre chipping and damage [16].	✓	1

5S	**Flexibility and future expansion:** It is not possible to expand vertica horizontally, because the building is prefabricated and designed for 10 floors, and it is not possible to e horizontally as well , due to the presence of parking spaces. [16]	✗	**1**
6S	**Applying the value review**: The value review was applied for Basmaya resi complex, where it was approved in order to provide appropriate housing for the Iraqi people, esp after no Construction being implemented from the eighties of the last century. This came to meet the Iraq's need for residential buildings by 10% of the need for a period of sever and at a price appropriate to the middle class of society at a value of $ 630 per square met payment is made in Installments [12].	✓	**1**
7S	**Re-use of building materials**: The building cannot be dismantled and reused o 10% of the used Materials as required by the Iraqi Green Architecture Code [16].	✗	**1**
8S	**Energy required for the production of building materials:** Iron, cemer cement blocks were used which are materials that require high and medium energy to be pr according to Table (5-2 / 2) shown in Appendix (1) section of choosing building materials and syst the eighth Requirement. So the requirement is not achieved to supply low-energy material	✗	**2**
9 S*	**The use of local building materials**: 14 factories have been established, three of which are main factories for walls, ceilings, floors and internal partitions, adjacent to Basmaya city with an area of 3 million m^2, as shown in figure (19), all of which depend on local materials and only modern Technology has been imported from abroad (16).  Figure (19) Factories complex site - Source Hanwha Company Website	✓	**2**
10 S	**Use of materials manufactured from recycled resources**: No recycled ma were used in Basmaya's buildings [16]	✗	**1**
11 S*	**Non-use of hazardous materials**: The hazardous materials mentioned in the table were not used in building materials such as asbestos, and wood treatment ma (chromatid copper arsenate) which affect people and the environment [16]	✓	**2**
12S	**The use of green or smart materials:** Smart or green materials were not u	✗	**1**

	Basmaya [16]		

Table (7) Application of the theoretical framework for indoor environment quality strategies (Prepared by the researcher)

S.	Indoor environment Section Requirement	A.	P.
1I*	**Natural ventilation**: all windows in Basmaya apartments can be opened windows and doors on Opposite sides to provide airflow.	✓	2
2I	**Building direction**: The building is in a U-shape, and the direction is not spe Each building has a different direction in Basmaya, and the buildings are not directed to the direc the prevailing Winds in Iraq (northwest).	✗	1
3I	**Windcatchers**: There are no windcatchers in the design of the buildings.	✗	1
4I	**Window direction**: all windows can be opened, and the building is U-shape window direction is Not specified, so each window has a different direction in the building.	✗	1
5I*	Chemical pollutants: No chemicals pollutants that negatively affect human were used [16]	✓	2
6I*	**Volatile organic substances (low emission):** The type of paint used in the environment of Residential apartments was (EMULSION paint). Poisoning with paint happens swallowed or entered into the eye, and the percentage of Volatile organic substance is 20 g i.e. less than 50 g / Liter [18]. The percentage of volatile organic substances for the floors was 1 liter, which is what is required by the code also in the table shown in Appendix (1) in the environment section, the Sixth requirement.	✓	2
7I*	**Acceptable noise standards in the indoor environment**: According to Table 1) of the Iraqi Acoustics Code, the acceptable noise standards for apartment spaces are expla Appendix (1) of the Indoor environment section, the seventh requirement. The measurement was by (DB METER) for the following Spaces. The results were as follows: For l (33) db, bedrooms (20) db, living room (23) db, bathrooms (35) db, that is, within the acceptable standard.	✓	2
8I*	**The acceptable noise standards by the mechanical systems**: The mecl systems used in apartments are:	✓	2

	A- Ceiling fan type (KDK), noise level is (62 db). B- kitchen ventilation fan type (KDK), noise level is (35) db C- Bathroom ventilation fan type (KDK), noise level is (45) db[19]. D- LG washer, noise level is (75) db. E- (TOSOT) air conditioner with a noise level of (56) db [20]. According to the acoustics code, the highest limit of the noise level for mecl equipment ranges from (60 db to 110 db), as shown in the appendix (1) in the section of the environment of the Eighth requirement. And that the mechanical systems used are tested in laboratories in order to comply with the required noise levels, then they are transported and ins meaning that the noise Of the mechanical systems used in Basmaya apartments is within the required l		
9I*	**Natural lighting in the building:** According to section five of the Iraqi N Lighting Code, the standards for acceptable lighting are explained in Appendix (1) in the section indoor Environment of the Ninth requirement. When measuring the values by Light m the middle of the space, the results Were as follows: The kitchen (280 lux), the room (312 lux), and the stairs (130 lux). It is Compliant with what is required by the Natural Lighting Code.	✓	**2**
10 I*	**Artificial lighting in the building**: According to the Iraqi Interior Lighting C section four, Table (4-1 / 1) shown in Appendix (1) of this requirement, shows the values of li required for Each Space. When measuring the values using Light meter, the results were as fo The kitchen (316 lux), The bedrooms (150 lux), the living room (190 lux), the elevators (180 lux), a stairs (440 lux). It complies with the requirements of the artificial Lighting Code.	✓	**1**

Table (8) Application of the theoretical framework for effective management strategies (prepared by the researcher)

S.	Effective Management Section Requirement	A.	P.
1 M*	**Building design completeness**: A complete design team was provided, startin the initial studies, appraisal costs, and long-term planning processes, which included specializat (architectural, civil, electricity, sanitary, mechanics, agriculture, in addit detailed designs for elevators, stairs, sections of walls, windows and doors) and developing complete plans in the arch	✓	**3**

	Basmaya residential Complex in the National Center for Engineering Consultation [13].		
2M	**Creativity**: A design which achieves 10% energy savings has not been adop other ways that are not Mentioned in the code [16].	✗	**1**
3 M	**Community awareness**: It is possible to hold awareness sessions for the comm on the design of Basmaya city and its advantages in the media and within effective community g such as unions, the Investment Authority and the Ministry of Housing, in o reach the decision-makers as well. Several scientific trips were were ma universities for engineering students to Basmaya city, as well as a Scientific trip by the Engineers Syndicate.	✓	**1**
4M	**Empowering human resources**: There is an Iraqi engineering department sup Basmaya project, And Iraqi engineers and craftsmen have been appointed to work on the project	✓	**1**
5 M	Cooperation with government departments: Basmaya city was established t governmental support to Hanwha company by the Investment Authority, which provided faciliti guarantees for foreign Investors [12].	✓	**1**

Table (9) Application of the theoretical framework for waste management strategies (Prepared by the researcher)

S.	Wastes Management Section Requirement	A.	P.
1* W	**Using or recycling and modification of construction waste**: Basmaya ci built with prefabricated building units to reduce construction waste as much as possible, so there construction waste that is 50% utilized or modified.	✓	**2**
*2 W	**Reducing construction waste**: Basmaya city was built with prefabricated b units to reduce Construction waste as much as possible.	✓	**3**
*3W	**Specific places for solid waste collection**: not required for residential comple	-	-
4 W	**The existence of specific places for collecting and sorting household waste** is a garbage dump for each building that is 31 meters away, and each apartment has a co number assigned to it, with an area of 2 * 4 = 8 m^2, but the waste is not sorted in it, it is sorted afte collected by the Garbage truck in order to determine the way of disposal.	✓	**1**
5 W	**The existence of specific places for waste storing and recycling**: There actual areas or	✗	**1**

	Methods with modern technology for recycling waste in Iraq, only plac landfill [21]. Therefore, there is no place been provided near buildings for waste keeping and recyc the future, but it is Possible to provide these places if methods of waste recycling were provi Iraq in the future.		

5- Results:

Each achieved requirements in each section with the points are as stated in the below table:

Basmaya Residential Complex									
The achieve Of requirem	Wa	Effective manager	Indoo	Building And materials	Sy	Water	Energ	Locat	Requirem Total	Point Total
Achieved	3	4	1	7		1		15	42	73
Unachieved	1	1	3	4		2		-	19	41

- According to the previous table, and by going back to table (1), we find that Basmaya residential complex has achieved one star from the code levels.
- That is, Basmaya Residential Complex is a green complex according to the Iraqi Green Architecture Code.

6. Conclusions:

To further upgrade Basmaya residential complex, the researcher suggests the following:

1- Replacing used windows of a single type with a double one.
2- Installing windows on the inner edge of the spaces.
3- Using solar cells on the roofs of buildings or any kind of innovative energies near the empty spaces around the complex.
4- Using the solar heater on the roof of the building.
5- Using the equipment shown in Appendix (1) in the water section, the first requirement to reduce water consumption in kitchens and bathrooms.
6-Using surface drip method for the recycled water instead of returning it to the river.
7- Using smart or nanoscale materials or systems, for example in the finishing.
8- Educating the residents about the importance of providing containers divided into several sections for recycling waste (plastic, paper, glass, iron ... and others)

Sources:

[1] **"The Report: Saudi Arabia** 2013" P.P.298
[2] www.worldgbc.org.
[3] Iraqi Building Codes and Specifications - Ministry of Housing.
[4] The Iraqi Green Architecture Code.
[5] The Iraqi Green Architecture Code, Section 9
[6] The Central Bureau of Statistics for the Iraqi Ministry of Planning.
[7] http://www.bismayah.org/
[8] http://www.bismayah.org/pages/01overview/BNCP.asp
[9] https://arab-arch.com/2122--.html
[10] http://www.bismayah.org/ Hanowa company official website.
[11] https://arab-arch.com/2122--.html
[12] An interview with the President of the Investment Authority (Mr. Sami Al-Araji) at the headquarter of the Investment Authority in Al-Khadra neighborhood.
(13) (The National Center for Engineering Consultations - Basmaya Archives)
[14] (Engineering Department - Basmaya)
[15] youtube.com/watch?v=uco0URNEbFU&t=481s
[16] An interview with the engineer (Ali Saad), Head of the Engineers Department at Basmaya Residential Complex.
[17] Handbook of urban housing standards.
[18] Jin-A Kim "**Measurements of Formaldehyde and TVOC Emission from Paints and Coating Materials using Small Chamber"** February 2012 · Journal of Wuhan University of Technology-Mater Sci Ed
[19] https://iprice.my/compare/kdk-k15v0/.
[20] https://www.amazon.com/TOSOT-Conditioner-Toshiba-Warranty-TM30ML201/dp/B07VD5M2NL?th=1
[21] http://www.cosit.gov.iq/ar/env-ind

Appendix (1): Table (9-2 / 2) of the Iraqi Green Architecture Code, which clarifies the requirements for each section, and it was modified, and the methodology used by the researcher and the corresponding points were added.

Note: - The (*) indicates that it is a basic requirement for green buildings.

Code	The requirement and its implementation mechanism required in the Iraqi Green Architecture Code	Measurement methodology used by the researcher	P.
Site Selection Requirements			

1 S	**Distance from urban centers**: It is necessary to plan to link with the nearest city by establishing a road network with a distance equivalent to 30 km	Distance measurement	**2***
2 S	**Protection of agricultural sites and natural reserves**: building and construction should not be exposed to wildlife sites and natural reserves.	Follow-up with The investment Authority	**1***
3 S	**Conserving heritage sites**: Preventing the trespass on heritage sites.	Follow-up with the General Authority for Heritage and Antiquities	**1***
4 S	**Interconnection with urban neighborhoods**: dividing each neighborhood into districts that have centers or corridors linked to each other, separated by a distance of 700 meters, and are linked by mass transport networks.	Distance measurement	**1**
5 S	**Dealing with the topography of the site**: going in line with the topography of the site so that the slightest possible change in the surface of the earth is made if it is tiered, flat or otherwise.	Reviewing site plan	**1**
6 S	**Infrastructure**: not exceeding the design limits.	Reviewing the previous plans.	**1**
7 S	**Afforestation:** Encouraging the cultivation of sidewalks, median strips and open spaces with trees suitable for the local environment, at a rate of 50% in a manner that does not hinder pedestrian movement.	Descriptive analysis and calculation of area	**1**
8 S	**Empowering people with disabilities**: saving about 10% of the total number of parking spaces for the vehicles of the people with disabilities. And the ability to deal with various building facilities and entrances.	Locating an area and measuring distance	**1***
9 S	**Encouraging bicycles**: Providing safe and shaded parking spots for bicycles within the building or at a place no more than 30 meters away from the entrance to the buildings.	Locating an area and measuring distance	**1**
10	**Ease of access to the location**: providing a paved road with a width not less than 1.5 meters to reach	Descriptive analysis	**1**

S	the location by walking from the main road. With it being at the same level as the main entrance to the building.		
11S	**Car parking**: if it is (multiple housing, then according to the number of apartments in the complex, one car per apartment).	Areas calculation	**1***
12S	**Green open spaces**: providing green open spaces greater than or equal to 30% of the total building area.	Areas calculation	**1***
13S	**Reducing the impact of urban heat islands**: taking into account the shading by planting trees or plants within 5 years of the time of occupancy.	Descriptive analysis and inspection of the exterior design.	**1**
14S	**Shading sidewalks and roofs**: Using light colors when tiling sidewalks and roofs.	The source of the reflection value of the solar index of the material.	**1**
15S	**Noise pollution**: According to the Iraqi Code of Acoustics, the acceptable level of outdoor noise at night is (45) DB, while in the day the required level is (50-55) DB	Using Testo 815 Device	**1***
	Points Total		**16**
Energy Conservation strategies			
1E	**Coordination of the building site**: Covering one of the facades of the building completely with climbing plants or planting a row of trees.	Viewing building facade and exterior design.	**3**
2E	**Building shape**: Using the parallelepiped shape with a ratio of 1: 1.2, or with a ratio of 1: 1.5, or using the cube shape. According to the following equation: Building shape factor = $\frac{the\ surface\ area\ of\ the\ building\ (walls+ceiling)}{the\ surface\ aarea\ of\ the\ reference\ cube}$	Reviewing the building plans.	**1**
3E	**Cases of building mass formation**: The building is connected to one side with one or more neighboring buildings.	A preview of the building with its neighbors.	**5**
4	**Building mass direction**: directing the building	Viewing the building's	**1**

E	to the north and south, north-east, south-west, south-east or northwest.	location and direction on google earth.	
5 E	**Burying of the building mass in the ground:** What is required is either that the building is completely buried or only 50% of it.	References of the building plans.	**7**
6 E	**Thermal insulation in the building envelope / walls:** The required value is 0.3 or what is equivalent in thermal insulation.	Calculation of insulation value for materials U-value	**7***
7 E	**Thermal insulation in the building envelope / roofs**: The required value is 0.27 or what is equivalent in thermal insulation.	Calculation of insulation value for materials U-value	**3***
8 E	**Shading the building facades of the buildings**: using sun breakers in front of the windows with a distance of 1 meter.	Viewing the Building façade.	**1**
9 E	**The window openings to the facade:** The ratio of window openings to the façade is equal to 20% for the residential.	Calculating the area of the windows compared to the area of the building facade	**6***
10 E	**The type and shape of the windows / the type of glazing**: double glazing required.	A preview of the type of the used glass.	**1**
11 E	**The type and shape of windows / the shape of glazing**: the use of windows in the transverse direction more than the longitudinal direction.	Measuring windows dimensions.	**1**
12 E	**The type and shape of windows / window installation**: Installing windows on the inner edge of the wall.	A preview of the installed window position.	**1**
13 E	**Solar cells, wind energy or innovative energies:** cover 50% -30% or more of the building needs for the energy without air conditioning.	Inspecting the type of energy used in the building.	**5**
14 E	**Solar heater**: Reliance on solar water heater for heating water in winter.	Inspecting the type of heater used in the building.	**4**
	Points Total		**46**

Water Conservation strategies			
1 WA	**Managing drinking water consumption in buildings**: choosing a water supply system and equipment that reduce consumption and waste of water.	Inspecting the type of equipment used in the building's bathrooms and kitchens.	**5**
2 WA	**Managing water consumption in plants irrigation**: the use of irrigation systems such as the drip method, which reduces the loss of water use.	Inspecting the type of equipment used for plants irrigation.	**4***
3 WA	**Gray water filtration and cleaning system**, The use of gray water for irrigation or domestic operations: The use of filtered gray water for irrigating plants or in domestic operations.	Inspecting the use of a filtration system in the building.	**4**
	Points Total		**13**
The Section of Strategies for managing building systems and materials			
1 S	**Efficient selection of the building system:** reliance on the prefabricated building.	Reviewing the previous plans.	***2**
2 S	**Determining the functional program**: define the functional program in the urban housing standards brochure.	Reviewing the previous plans.	**1**
3 S	**Simplicity in design and implementation:** simplicity in design and implementation.	Reviewing the previous plans.	**1**
4 S	**Modularity and Standardization**: Reliance on modularity and standardization.	Measuring the distance and area of the materials used.	**1**
5 S	**Flexibility and future expansion**: The possibility of flexibility and future expansion of projects.	Reviewing the previous plans.	**1**
6 S	**Application of the value review**: adopting the value review of buildings.	Reviewing the previous plans.	**1**
7 S	**Reuse of building materials**: 10% possibility of reusing the building materials.	Reviewing the age of the used building materials.	**1**
8 S	**Energy needed to produce building materials**: Using materials that require low-energy in their	Reviewing table (2-2 / 5) in the Iraqi Code.	***2**

	production.		
9 S	**Use of local building materials**: Use of local building materials.	Reviewing with the building implementers.	***2**
10 S	**Use of materials manufactured from recycled resources**: Use of manufactured materials that have been recycled at a ret of 10%.	Inspecting the materials used in the building.	**1**
11 S	**Non- use of hazardous materials**: non- use of hazardous materials.	Inspecting the materials used in the building.	***2**
12 S	**The use of green, smart or nanoscale materials**: using these materials in the building.	Inspecting the materials used in the building.	**1**
	Points Total		**16**
Strategies of the indoor environment quality			
1 I	**Natural ventilation**: Provide openable windows, and openings of door facing the openings of windows for airflow.	Viewing the building and plans.	***2**
2 I	**Building direction**: The openings must be placed in the direction of the prevailing winds that come in the summer from the northwest, then west and north in most parts of Iraq, especially Baghdad**.**	Viewing the building's location and direction on google earth.	**1**
3 I	**Windcatchers**: must not be less than one square meter.	Reviewing the building plans.	**1***
4 I	**Window direction**: Windows placed in the direction of prevailing winds.	Viewing the building site and windows direction on google earth.	**1**
5 I	**Chemical pollutants**: not to use chemically polluted materials.	Using a special floor at the entrances to the building and measuring the percentage of chemical pollutants.	**2***
6 I	**Volatile Organic substances (Low Emission)**: Reducing the effect of volatile Organic substances.	Checking the percentage of volatile organic substances of	**2***

		the materials used in the building interior.	
7 I	**Acceptable noise standards in the indoor environment**: the acceptable noise standards in the indoor environment for the various building types must comply with the standards set in the Iraqi Acoustics Code (Third Section)	Using DB Meter app	**2***
8 I	**Acceptable noise standards by the mechanical systems:** and acceptable noise standards for mechanical ventilation systems in the Iraqi Code of Acoustics.	Reviewing the amount of noise for each device used inside the building.	**2***
9 I	**Natural lighting in the building**: you can review the Iraqi Code of Natural Lighting (Fifth Section) to determine the levels of natural lighting required for the various spaces.	Using the Light Meter app.	**2***
10 I	**Artificial lighting in the building:** you can review the Iraqi Code of indoor Lighting to know more about the standards of the artificial lighting in buildings**.**	Using the Light Meter app.	**1***
	Points Total		**16**
Effective Management Strategies			
1 M	**Completeness of building design**: a complete design team is provided that includes specializations of (architectural, civil, electrical, sanitary, mechanical, and others as required by the style of the building or project).	Reviewing the previous plans.	**3***
2 M	**Creativity:** saving energy outside of what was proposed in the code, and it has been proven to actually save energy for every 10% of energy saving in the building.	Measuring the extent of reducing energy consumption by 10% in a way not mentioned in the Iraqi Code.	**1**
3 M	**Community Awareness:** holding awareness sessions fixed in construction project documents, for residents of the residential neighborhood and for construction professionals on the benefits of energy saving and training on the adoption of	The existence of supporting documents for community awareness.	**1**

	environmental treatments in buildings.		
4 M	**Empowering human resources**: existence of supporting documents to empower human resources.	The existence of supporting documents to empower human resources.	**1**
5 M	**Cooperation of government departments**: the presence of government involvement, included in the documents of establishing construction projects for the specialists in the construction field.	The existence of supporting documents for the cooperation of government departments.	**1**
	Points Total		**7**
Waste Management Strategies			
1 W M	**Using or recycling the construction waste:** reusing or recycling and modification of about 50% of non-hazardous building waste.	Reviewing with the building implementers.	**2***
2 W M	**Reducing construction waste**: Reducing construction waste by no less than 50%.	Reviewing with the building implementers.	**3***
3 W M	**Specific places for solid waste collection:** the presence of specific places for solid waste collection with an area of not less than 10 m^2.	Reviewing the plans and locating a place for solid waste collection.	**1***
4 W M	**Specific places for household waste collection and sorting**: The presence of specific places for waste collection and sorting.	Reviewing the plans and locating a place for household waste collection and sorting.	**1**
5 W M	**Specific places for storing waste for recycling**: Specific places for waste storage for recycling and sorting.	Reviewing the plans and locating a place for collection and storage of waste for recycling	**1**
	Points Total		**8**