MINAR International Journal of Applied Sciences and Technology
ISSN: 2717-8234
Article type: Research Article

Received: 05/12/2023 **Accepted:** 02/01/2024 **Published:** 01/03/2024

EVALUATION OF PHYSICAL PROPERTIES FOR LOCAL NATURAL STONES

AREA STUDY: (ANBAR DESERT)

Sabah Noori HAMMOODI [1]

AShur University Collage, Iraq

Adil Hatem NAWAR [2]

University of Anbar, Iraq

Ahmed Adnan SAED[3]

University of Anbar, Iraq

Abstract

This research topic is important to researching the using of local natural stones, as basic building material in construction works, during from studying physical properties. These results checking with standard Iraqi specification (1387)/1989.

To achieve the aim of the research has been depend on:

1-The lot of quantity of these materials nearest the using locations.

2-The transportation costs are decreasing.

3-Producting possibility and give more designing methods.

4-Climate limitations of this area, refused product blocks.

5-Increase the cost of another construction materials like bricks.

Models were taken for three production sites for limestone, which have large reserves, and their proximity to cities had a great impact on the selection, namely:

1- Al-Qaim region, west of Anbar.

2- Kubaisa area, west of Hit.

3- Al-Jebha area (kilo 60), southwest of Ramadi.

As the results showed that the physical properties of this material, the compressive strength was (26.02, 26.6, 23.3) Mpa. for the sites (Jebha, Al-Qaim, Kubaisa), respectively, in comparison with the Iraqi Standard (1387). As the compressive strength of class (A) was determined to be (12Mpa). As for the density, it was (2305, 2120 and 1760) kg / m3 for the above sites, respectively. It is within the Iraqi standard, which specifies (1750, 2150, and

http://dx.doi.org/10.47832/2717-8234.18.8

[1] sabah.noori@au.edu.iq

[2] adilhatem311@uoanbar.edu.iq

[3] ahmed.adnan@uoanbar.edu.iq

2550) kg/m3 for the three classes (A, B, and C). As for the other specifications, such as absorption, fracture and corrosion standards, they are within the limits of the Iraqi standard. The research reached the possibility of using natural stone in construction works, especially housing in hot areas due to its good nature in terms of standard physical properties**.**

Keywords: *Stones, Physical Properties of stones, Anbar Desert.*

Introduction

The demand for energy increases to operate buildings in different areas, whether hot or cold, its goal is to reach the degree of thermal comfort in the building concerned. This has been dealt with by many studies and research aimed at balancing the climatic determinants and the design requirements of the building that achieve its environmental efficiency, from several design axes, as the axis related to the building material enters as a basis for the orientation of the structural design of the building functionally and the architectural idea that is supposed to be inspired by the heritage of the region According to the social nature.

Moving away from the architectural and structural style in the building of the hot areas (intended for research), moving away from insects and being influenced by ideas far from a style consistent with festivals and celebrations. Many types of construction materials came from there, most notably bricks, their high cost, and concrete blocks, with their minor and structural problems. Forgetting the natural matter that is utilized in electronic conditions and configurations, which is the natural matter with its computational types and different physical properties.

The research aims to determine the ranges in which the stone with its physical characteristics is from the Iraqi standard (1387) for the year 1989. As models were taken for three sites on the basis of:

1- The available reserves in these sites.

2- Proximity to areas of use.

3- Ease of production, architectural formation, and multiple places of use.

4- Other reasons related to the difficulty of obtaining other construction materials such as bricks.

5- Climate motives limited the uses of concrete blocks, such as blocks.

The research came on the hypothesis that (the availability of stone material in large quantity supports the tendency to use it in construction work. As well as its compatibility in chemical composition with the surrounding climatic conditions, which means its resistance to chemical influences).

The research adopted a method that combines practical and descriptive application to identify and measure the properties of this substance in the physical and mechanical aspects.

All this is to enhance the structural and environmental importance of this material in the technical uses at the building level, as a basic or finishing material that achieves architectural aesthetics and environmental improvement of the building's internal environment. Studying the physical properties as one of the determinants of use determines the importance of stone in the diversity of formation and use.

The research problem:

The research problem can be identified through the following inquiries:

1- The country has very large reserves of stone with a variety of characteristics. Why was it not used in an ideal way as a basic building material approved in our facilities?

2- Where are we from the reservoirs of our desert in terms of economic data, except for some agricultural surveys?

3- Do the physical properties of the stone material used in construction give it a field advantage in use compared to the imported building materials?

Hypothesis:

The research problem, through the propositions it contained, resulted in formulating the hypothesis according to the following elements:

1- Stone in all its types is a material that can be used with the determinants of space, time and environment (climate and geology).

2- Availability of stone material in a large quantity that supports the tendency to use it in construction works.

3- Its consistency in chemical composition with the surrounding climatic conditions, which means its resistance to chemical influences.

Research importance -

The importance of the research is shown by shedding light on the methods used by countries to deal with urban congestion in important cities, and then analyzing the location of the new Ramadi city project in terms of spatial and functional aspects, in order to reach convictions confirming that such a project needs to be studied by a planning team that establishes programs With planning alternatives that prepare the way to choose the best ones when starting implementation.

1: Natural stone and its properties:

1-1: Natural stone:

Stone is one of the natural materials that have been used in construction and other works since the emergence of human civilization, and it is still used because it retains its architectural, aesthetic, engineering, and environmental value, and it is available in regions of the world, including Iraq, whose lands enjoy abundance and abundance of this material. It expresses the local architectural styles, as well as its hardness and resistance to natural and weather factors, in addition to its beauty as a natural decorative material with colors, luster and texture.

Stone is an important material for all ages, up to the present and the future, due to its distinct properties, which will be explained later.

The stones are divided in terms of their formations into stones of fiery origin, such as: granite, basalt or sedimentary such as limestone and slate . Sandstone or metamorphic stone such as marble and slate. It is distinguished . Sedimentary rocks clearly form layers or natural bedrock.

For stones, the resistance of limestone depends on the degree of its amalgamation

The higher its specific gravity, the greater its resistance to alumina. The resistance of sandstone depends on the type of material binding it. Which consists of silicate, alumina, and lime, and the higher the percentage. The more silica in the binder the higher the resistance of the sandstone.

Stones are divided in terms of their composition into stones of fiery origin, such as:

granite, basalt or sedimentary such as limestone and slate, sandstone or metamorphic stone such as marble and slate. And it is distinguished. Sedimentary rocks clearly form layers or natural bedrock.

For stones, the resistance of limestone depends on the degree of its amalgamation

-The higher its specific gravity, the greater its resistance to alumina.

-The resistance of sandstone depends on the type of material binding it

Which consists of silicate, omina, and lime, and the higher the percentage

-The more silica in the binder the higher the resistance of the sandstone.

1-2: Study area stone:

Many studies were conducted on the soil of Anbar Governorate, including a study (Al-Bayati and Al-Rawi, 2002) to diagnose the separation of silt and clay, which resulted in the dominance of quartz, then illite, and then chlorite, with the presence of a few clay minerals such as kaolin.[1].

The study also carried out by Al-Rawi (2003), in studying the sand separator for the soils of the Al-Kaara and Al-Hussainiyat depressions, noted that the percentage of heavy metals constituted (11-14)% by weight of the minerals of the sand separator, and he noted that there was a similarity between the minerals of the region, with only different quantities.[2].

The geology of Anbar Governorate is clearly covered by a sharp-edged rock layer composed of limestone, flint, and parts of basalt stone.

Solid rocks are often observed on the edge of the river valley and the shoulders of the valleys, extending from the Al-Qaim area to Hit, at depths exceeding (65) meters.[3].

The importance of studying it in this research is based on its use as a widely used building material due to its sustainability properties obtained from the effects of the surrounding conditions, the quantitative abundance of its reserves, and its spread over multiple areas and many locations.

1-2: Geological Classification of natural stone:

Stone is classified according to geological characteristics and formation areas into types:[4]

First: Volcanic Stones (Igneous Rocks): including granite, the strongest type of stone and difficult to shape before the advent of machinery. It is found in abundance in Arab countries, including Iraq and Egypt. It has many colors, from red, colored, dark white and black, and has aesthetic properties. Its durability is (750-1300) kg/cm2. Basalt belongs to this type, and is satin because it is cooled by air on the surface of the earth and not inside it, unlike granite. **Second:** Sedimentary Stones: Limestone is the most important type, which in turn is of types used for construction purposes such as (coal, dolomite, sandstone, limestone). Sandstone consists of quartz grains that are naturally bonded with strong cohesion and are easy to form. Its durability is (100-150) kg/cm2. It is called limestone when it contains more than 50% of the mineral calcite (CaCO), Figure (1). As for dolomite (CaMg-(CO3)2), it contains, in addition to calcium, the element magnesium.[5].

Figure (1) Limestone type sedimentary stone

Resource: [2].

It is considered one of the important industrial rocks when it is pure, and is used in the manufacture of cement, glass, iron production, the manufacture of thermal insulation wool, and the ceramic industry, in addition to being a basic building material. Figure (2) shows dolomite stone formed by dolomitization (the transformation of limestone into dolomite). It is used in the production of aggregate needed for road works, reinforced concrete, and the manufacture of tiles and limestone blocks. It is also used in the refractory industry to line furnaces and molds used in steel production. (For more, see: Sarsam and Abdel-Aali, Construction Materials, 2006). [6].

.

Figure (2)Dolomite stone is one of the types of sedimentary rocks
Resource: [7].

Third: Transformed rocks: Sometimes they are called metamorphic, such as black slate, and they are mostly used in road pavers and sidewalks. Their durability is (30-150) kg/cm2.

In general, Iraq is one of the Arab countries that most used stone in construction work. The most important stones available in Mesopotamia are limestone, limestone sandstone, crystalline gypsum, marble, and types of granite. These types are spread in a large arc that begins in the central-western region of Iraq, with deposits spread here and there, limestone once and gypsum again, then it rises northward, increases, and turns into sandy limestone and into sandy limestone. Gypsum plaster around the city of Ramadi. [8].

1-3: Chemical Classification of natural stone:

Stones are classified according to the compounds they contain:

A: Stones that contain mainly silica, such as quartz. -

B: Stones that contain silicates and other minerals. Silicate minerals contain feldspar, which -

It is an aluminum silicate with lime and potassium and is clear red or pink

If aluminum silicate is mixed with iron, its color becomes black brown.

C: Stones containing calcareous minerals, which are either calcite, i.e. calcium carbonate.

Pure or dolomite i.e. calcium carbonate with magnesium. Same source. [9].

1-4: Natural stone and artificial stone (general comparison):

The research focuses on the role of natural stone in determining the environmental impact on housing when used, whether as a building material or finishing material. However, due to the necessity of evaluating the characteristics, it is necessary to compare it with manufactured stone, especially with regard to the finishing stone of the building from the outside.

Natural stone is superior to artificial stone in that it is a natural material with varying surfaces and colors , (It is not identical) and adds more luxury than artificial stone, and its lifespan is greater than.

The expected lifespan of artificial stone, as the longest warranty period can be obtained (39) years is better - for artificial stone it is (15) years, and its expected life may reach (25) years. Natural stone is older than the building itself.[10].

Natural stone constitutes the basic building unit, especially in facade finishes and wall construction. When choosing the stone material for construction, it is necessary to determine the type and amount of loads it will be exposed to when used, as well as the service, climatic conditions, age of the building, and the cost of the stone.

Table(1)

Comparison between natural and artificial stone

No.	Property	Natural Stone	Artificial stone
1	Genesis	Due to geological and climatic periods	Made from raw materials with industrial properties
2	Formation	Good formability and produced in various geometric shapes	It is manufactured in a variety of sizes and cannot be changed after manufacturing
3	the color	Varies from one piece to another	Produces multiple balloons in quantities of the respective color
4	Cost	Relatively high due to transportation cost	Suitable in terms of its manufacture near the sites of use
5	the quality	High quality to produce many shapes	Simple in terms of its architectural quality due to the stability of its shape

Resource: Researchers

This is in addition to the difference in technical characteristics and specifications in terms of corrosion, endurance, absorption, breakage,...... etc.

2: Experimental Work:

2-1:An analytical study of models of some stone sites in the study area:

It is known that every construction material undergoes several tests in order to ensure its use in facilities in general. Among these tests are the ones that are most reliable in practical life, as they give the simplest results that are said to be the effective elements in controlling the construction material in use.

In order to determine the possibilities of local quarantine (quarantine of the study area), models were adopted for three basic areas in terms of the amount of reserve, the cost of transportation or visual inspection, and their proximity to sites of use.

Since the goal is to verify the ability of the local quarantine to achieve a standard that is close to or better than the Iraqi standard and close to the international standard. He encouraged this and gave priority to the areas whose stone material properties were studied:
1- There is a large reserve of this substance in desert areas. See Table (2), which shows the reserve for each of the studied sites.

2- The proximity of these sites to areas of use. This reduces transportation costs and thus reduces the cost of this material.

3- Easy to form and manufacture multiple geometric shapes from this material, according to need, location, and architectural style.

4- The climatic characteristics of the region, including its extreme heat and dryness.

5- Reduced costs of quarrying, shaping, use and processing.

6- The cost of other (alternative) building materials, such as bricks, for example.

Models of three limestone production sites, which have large reserves and their proximity to consumption (market) sites, had a major impact on selection and testing. (See Table (2)) which are:

- Al-Qaim region, west of Anbar.
- Ain Al-Arnab area / Kubaisa, west of Hit.
- Front area (kilo 60), southwest of Ramadi.

Basic laboratory tests were conducted on it to indicate the extent of its use in construction and finishing works.

Stone type models were tested on the basis of:

First: its abundance (available reserve).

Second: Its cost (including the cost of transportation as a major influencing factor).

Table (2-A)

Reserve quantities of stone in the study area

Type of Stone	**Location**	**Reserve quantity (Mellon Tons)**	**General Uses**	**Physical Properties**
Limestone	Al-Ghadaf = 80 km southwest of Ramadi	202,52	-White cement industry - Construction	- White color.
Limestone	Abu Jir (50) km south of Ramadi	69,64	- Cement and ordinary industry - White cement industry - Internal partition construction works.	- High density. - It breaks down with water. - White in colour.
Limestone	35 km south of Hit in Ain Al-Arnab	144,68	- Ordinary cement industry. - Construction works.	-White. - Its density is (2060) kg/m3.
Limestone	(15) km from H3 - Rutba	778,84	- White cement industry. - Construction works.	-The color is light brown. -Density (2500) kg/m3

Limestone	80 km north of Rutbah. Wadi Sawab	4286	- Ordinary cement industry - Building	-Density (2450) kg/m3 - White in colour
Limestone	Al-Tanf and Al-Nahidain	328,42	-Ordinary cement. - Not suitable for construction	-Density (2796) kg/m3 -White in color and very solid
Limestone	- Wadi Al-Kharja (30 km) east of it. - Wadi Quneitra - Wadi Al-Qaim and Al-Mana'i	1 0,591 4,785	-It is used for cement internally -It uses simple tasks to implement the execution plan -The colored type is used in correspondence works due to its solid facades.	- Bearing (325-375) kg/cm2 - Bearing (193-819) kg/cm2 - Bearing (242-380) kg/cm2 -For all sites, the stone is white, brown, and light red. - -Density: 2700 kg/m2
Limestone	Makr Al-Dhib is 75 km from Al-Qaim	2,8	- Construction works. - Manufacture of white and ordinary cement	Gradation of color from white to red The thickness of the layer reaches (20) meters
Limestone	Wadi Al-Ghadaf	124,5	- White cement industry. -Glass industry.	The color is white-brown
Limestone	Wadi Al-Ghadaf (95 km southwest of Ramadi).	820	- Ordinary cement industry - Construction works	-The thickness of the layer is more than (20) metres. -Color gradation.
Limestone	A front (47) km southwest of Ramadi	3,5	-Basic building stone. -Cutting and cutting stone. -Ordinary cement industry.	-Density (2050) kg/m3 - Oolitic limestone. - It alternates with marl and dolomite. -The thickness of the layer is (4.5) metres.
Limestone	Abu Safiya (8 km southwest of Shathatha)	52	- Manufacture of ordinary cement and silk - Construction works.	-The thickness of the layer is more than (3) metres. -The color tends to red.

Resource: [11]

Table (2-B)

Types, locations, quantities and uses of stone in the study area

Type of Stone	Location	Reserve quantity (Mellon Tons)	General Uses	Physical Properties
Dolomite	Wadi Al-Fahimi (30) km west of Al-Haqlaniyah (Haditha).	1,045	- Cutting and packaging of facades. - Construction works	-The color is solid yellowish white -Dolomite limestone rocks - Endurance (128-301) kg/cm2 -Absorption (5.6-13.6)% -Density (1850) kg/m3
Dolomite	Wadi Halba - Abu Jir (60) km south of Ramadi	20,210	- Construction works. - Cutting and packing facades	-The color is yellowish white and solid. -Dolomite limestone rocks. - Endurance (100-350) kg/cm2 -Absorption (4.7-11.8)% -Density (1865) kg/m3
Dolomite	Al-Hatmiyyah (3) km northwest of Al-Baghdadi	2,061	- Construction works - Cutting and packaging works	-The color is white-brown and very solid. -Dolomite limestone rocks. - Endurance (334.5) kg/cm2 - Absorption (2.6-5.6)% -Density (2355) kg/m3
Dolomite-Limestone	Al-Rutba area (3.5 km) east of Al-Rutba. Depth (50) meters.	300 Of which (6) are of high purity	- Manufacture of high-purity glass and window glass. -Magnesia production. -Construction work.	-The color is white, brown and solid. -Dolomite rocks. -Absorption (1.63-6.11)% -Density (2230) kg/m3
-Dolomite Limestone	abha and Ramadi regions	0,728	- Manufacture of high-purity glass and window glass. -Magnesia production. -Construction work.	-The color is yellowish white and has little hardness. -Dolomite rocks. -Porosity (32%) -Density (2050) kg/m3

Dolomite-Limeston	Al-Husseiniyat area (305) km from Ramadi - (7) km by expressway. - (50) km north of Rutba	167,63	- Manufacture of high-purity glass and window glass. Construction work.	- Gray to light and solid lead Dolomite rocks. - Endurance (1297) kg/cm2 Absorption is less than 4%. Density (2037) kg/m3
Dolomite	Al-Karaa and Al-Mamlosa	The quantity is not specified because it is a mixture	Building materials. Production of building materials. - Glass and magnesia industry.	A mixture of dolomite, kaolin and sandstone. Thickness: 20-50 metres

Resource:[12].

2-2:The Tests:

2-2-1:Density Test:

1- Results of Test:

A density test was conducted for the samples used from the mentioned sites, at a rate of (6) cubes for each model. Figure (3) shows the stone cube models used in the test, which were formed with dimensions of approximately (10 x 10 x 10) cm. The average results were compared with the two standards (Iraqi 1387 and ASTM International Standard). The devices shown in Figure (4) were used in the test after calculating the dimensions of each cube. The results for the three fluid models were as shown in Tables (3), (4), and (5). Density was calculated through the following equation:

Density=Weight(Kg)/Volume(m^3)---------(1)

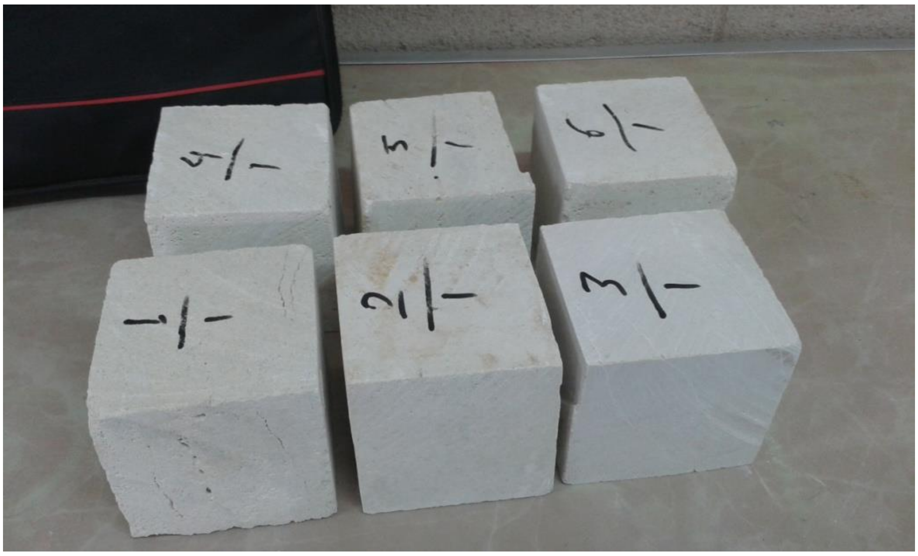

Figure No. (3)

Some stone cubes used in the test

Resource: Researchers work

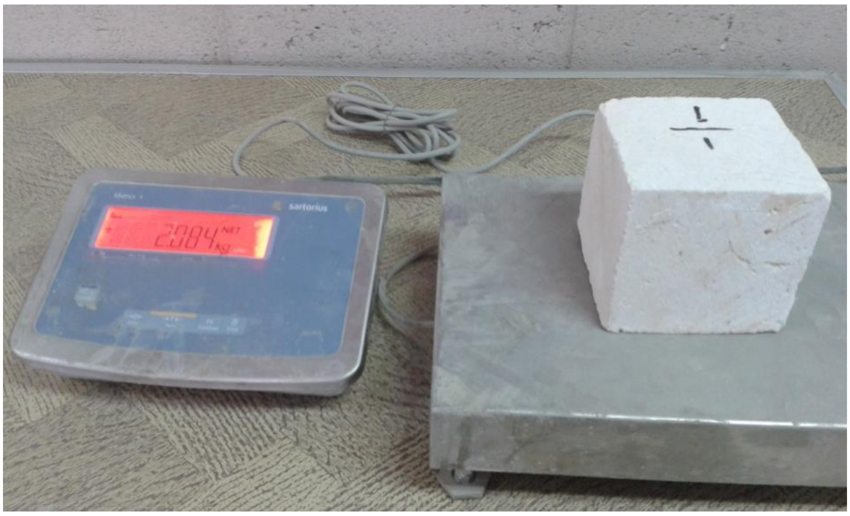

Figure (4) Weight measuring device for models

Resource: Researchers

Table (3)

Density test results for stones at Kilo (60) site, west of Ramadi-Iraq

Model	Number Cube	Dimensions (m)			Weight (Kg)	Density (Kg/m3)
		length,	width,	height		
1	1	0.104	0,104	0.101	2.085	1908.6
1	2	0.103	0.104	0.103	2.538	2300
1	3	0.105	0.103	0.104	2.852	2536
1	4	0.106	0.103	0.103	2.521	2242
1	5	0.102	0.095	0.105	2.630	2585
1	6	0.109	0.103	0.106	2.691	2261
Modified value						2305

Resource: Researcher based on laboratory test results

Table (4)

Density test results for Al-Qaim site stone

Model	Number Cube	Dimensions (m)			Weight (Kg)	Density (Kg/m3)
		length,	width,	height		
2	1	0.101	0,100	0.101	1.973	1953.73
2	2	0.100	0.102	0.101	2.016	1956.90
2	3	0.102	0.102	0.100	2.314	2224.14
2	4	0.102	0.101	0.102	2.231	2123.14
2	5	0.100	0.102	0.103	2.404	2288.2
2	6	0.103	0.101	0.103	2.302	2169.85
Modified value						2119.33

Resource: Researcher based on laboratory test results

Table (5)

Density test results for Kubaisa site stone

Model	Number Cube	Dimensions (m)			Weight (Kg)	Density (Kg/m3)
		length,	width,	height		
3	1	0.102	0,101	0.101	1.806	1735.7
3	2	0.103	0.100	0.101	1.765	1696.6
3	3	0.104	0.102	0.104	1.992	1805.6
3	4	0.102	0.103	0.101	1.869	1761.4
3	5	0.102	0.102	0.101	1.826	1737.7
3	6	0.105	0.103	0.102	2.013	1824.8
Modified value						1760.3

Resource: Researcher based on laboratory test results

2-Analysis of the results:

From the results recorded in Tables (3, 4, 5) above for the density tests for the three sites, the stone density for the Kubaisa site gave an average density of (1760.3) kg/m3, followed by the Al-Qaim site with a value of (2119.33) kg/m3, then the West Ramadi site was denser. A rate of (2305) kilograms/m3 was recorded. This indicates that the Kubaisa site is the best to use in terms of density, because the lower the density, the less the load placed on the foundations and thus reduces the cost of the foundations and the cost of soil treatment.

2-2-2: Compressive strength test:

1-Test results:

Compression testing is one of the physical (mechanical) tests conducted on building materials, such as stone. It means the resistance of the material to the applied axial pressure forces to the extent that the material breaks or changes its shape.

The standard concrete cube inspection device, Figure (5), was used according to the usual method

In testing the endurance of concrete cubes, the stone was cut into cubes (10 x 10 x 10) cm using special cutting devices for such tests. Figure (6).

Figure (5)

Compressive strength testing device used

Resource: researchers

Figure (6)

Some cube models used in the research experiment

Resource: researchers

The results of the compressive strength examination according to the concretion site were as in Tables (6), (7) and (8) below. Compression was calculated using the equation;

$$ð = \frac{F}{A} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(2)$$

When: F: applied load (KN).

A: Surface area of the model in contact with the device (mm).

ð: Compressive strength (N/mm2).

Table (6)

Results of compressive strength testing of stone at Kilo (60) site, west of Ramadi

Model	Number Cube	Dimensions (m)			Maximum load (KN)	Compressive strength (MPa)
		length,	width,	height		
3	1	104	104	101	157.22	14.51
3	2	103	104	103	220,2	20.6
3	3	105	103	104	356.1	32.9
3	4	106	103	103	161.9	14.8
3	5	102	95	105	428.4	44.2
3	6	109	103	106	327.1	29.1
Modified value						26.02

Resource: The researchers based on the results of laboratory testing

Table (7)

Compressive strength test results for Al-Qaim site stone

Model	Number Cube	Dimensions (m)			Maximum load (KN)	Compressive strength (MPa)
		length,	width,	height		
2	1	101	100	101	206.5	20.44
2	2	100	102	101	263.3	25.81
2	3	102	102	100	231.4	22.24
2	4	102	101	102	293.8	28.52
2	5	100	102	103	339.1	33.24
2	6	103	101	103	305.7	29.39
Modified value						26.60

Resource: The researchers based on the results of laboratory testing

Table (8)

Compressive strength test results for Kubaisa site stone

Model	Number Cube	Dimensions (m)			Maximum load (KN)	Compressive strength (MPa)
		length,	width,	height		
2	1	102	101	101	188.3	18.3
2	2	103	100	101	216.5	21.0
2	3	104	102	104	241.5	22.7
2	4	102	103	101	217.7	20.7
2	5	102	102	101	209.4	20.2
2	6	105	103	102	247.8	22.9
Modified value						21

Resource: The researchers based on the results of laboratory testing

2-Analysis of the results:

From observing the results in Tables (6), (7) and (8), it became clear that the standing stone gave more bearing strength than the other two sites, so the modified value of compressive strength was (26.60) MPa. This provides evidence that the stone of this site is more solid than the other two sites, and the stone of the site of Kilo (60) west of Ramadi is close to it.

2-2-3: Absorption test:

1-Test results:

When conducting an absorption test for the local building stone of the study area (limestone), it must reach the limits of the two specifications (Iraqi M.S.C. 1387/1989 and American).The two specifications set absorption rates according to what is indicated in Table (9).

Table (9)

Limits of the Iraqi and American specifications for the water absorption rate of building stone

Item	Iraqi Standard (1387) (%)	ASTM-C97(%)
A	12	3
B	7.5	3-4.2
C	3	4.2-7.5

Resource: [13] [14]

In the research experiment, (3) models and (6) cubes were used for each model. The models were placed in a basin of water at laboratory temperature for (24) hours. It was taken out of the water and the examination process was carried out by weighing the samples used before and after drying. See Figure (6), [It was placed in the oven for (24 hours) at a temperature of (180) degrees Celsius] and Figure (7) shows this.

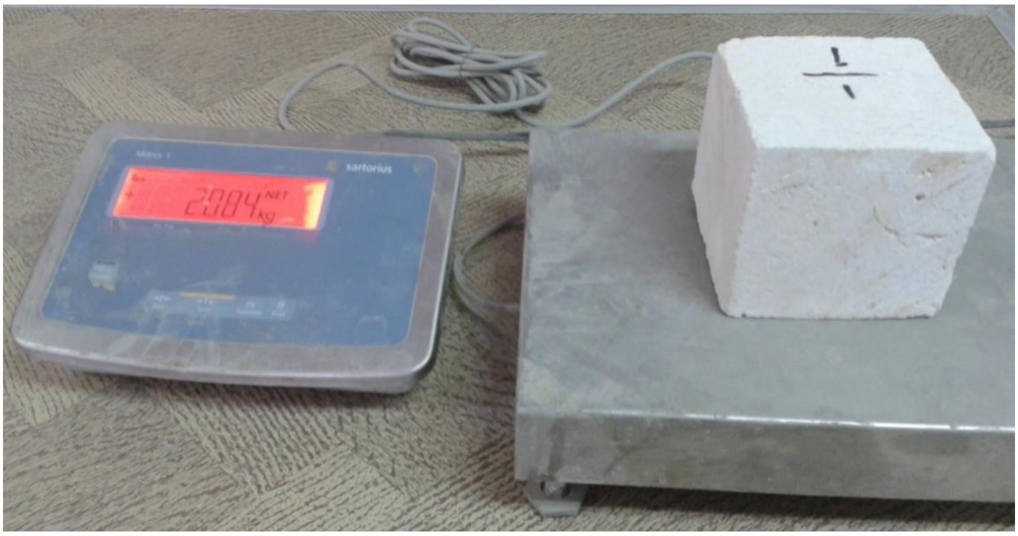

Figure (6) digital model weighing device

Resource: The researchers

Figure (7) The oven used in the experiment

Resource: The researchers

After carrying out weighting operations for the models used, the results appeared in tables (10), (11) and (12). The following equation was adopted to calculate the absorption rate of the models:

Absorption=[(W2-W1)/W1]*100-------------------------- (3)

When; W1=Dry weight

W2=Wet weight

Table (10)

Absorption test results for stones at Kilo (60) site, west of Ramadi

Model	**Number Cube**	**Dry weight (W1=Kg)**	**Wet weight (W2=Kg)**	**Absorption (%)**
1	1	2.537	2.623	3.4
1	2	2.371	2.463	3.9
1	3	2.833	2.876	1.5
1	4	2.438	2.532	3.9
1	5	4.011	4.106	2.4
1	6	2.370	2.480	4.6
Modified value				4.0

Resource: The researchers based on the results of laboratory testing

Table (11)

Absorption test results for Al-Qaim site stone

Model	**Number Cube**	**Dry weight (W1=Kg)**	**Wet weight (W2=Kg)**	**Absorption (%)**
2	1	2.166	2.259	4.3
2	2	2.065	2.118	2.7
2	3	1.996	2.048	2.6
2	4	2.618	2.702	3.2
2	5	2.408	2.493	3.5
2	6	2.314	2.417	4.5
Modified value				3.46

Resource: The researchers based on the results of laboratory testing

Table (12)

Absorption test results for a Kubaisa site stone

Model	**Number Cube**	Dry weight (W1=Kg)	Wet weight (W2=Kg)	Absorption (%)
3	1	2.126	2.263	6.4
3	2	1.977	2.125	7.4
3	3	1.807	1.965	8.7
3	4	1.786	1.938	8.5
3	5	1.913	2.040	6.6
3	6	2.004	2,147	7.2
Modified value				7.47

Resource: The researchers based on the results of laboratory testing

2-Analysis of the results:

Through the results shown in tables ((10), (11), and (12)), it was found that the standing stone gave a water absorption rate of (3.46%), followed by the kilo stone (60), which gave a water absorption rate of (3.46%). 4%), then leap stone, which gave the highest percentage of water absorption (7.47%). This is evidence that Qaim stone is more consistent and pure than the other two types and is preferred for use over other types, especially in external finishes.

2-2-4: Corrosion test:

1- Corrosion test results:

The purpose of this examination is to determine the stone's resistance to corrosion as a result of exposure to external factors that cause a change in shape, dimensions, and tolerance and thus affect use.

The method of conducting the examination was through the use of samples from the three sites, as (2) samples were used for each model with different weights. The following devices were used to conduct the examination:

- Drying oven to temperature (105) C°.
- Sensitive balance.
- Series of regular sieves according to ASTM system.

-The Los-Angeles Abrasion Resistance device with its accessories consists of a rotating cylindrical box with a diameter of (70cm) and a width of (50cm), rotating at a rate of (33RPM) with steel balls with a diameter of (47mm) weighing (0.42kg) and a digital counter to count the number of revolutions made. The device rotates it, in addition to the unloading box, which is rotated by a motor installed on the side. See Figure (8).

Figure (8)

Los Angeles device used in the experiment

Resource: The researchers

Table (13)

Weights of stone models used in the research.

Models	**Weights (Kg)**		
	Stone models (60)	**Al-Qaim stone models**	**Kubaisa stone models**
1	3.693	3.378	2.785
2	3.585	3.412	2.754

Resource: The researchers

Table (14)

Abrasion test results for stone specimens for the three sites.

Models / Sieve Size (mm)		**Weight of passing and remaining stone (g)**					
		Kilo (60) Stone		**Qaim Stone**		**Kubaisa Stone**	
		1	**2**	**1**	**2**	**1**	**2**
Passing from	19mm	2119	2204	2367	2417	1592	1654
Remaining on	19mm	1574	1381	1011	995	1193	1100
Passing from	12.5mm	1816	1776	1805	1883	1236	1309
Remaining on	12.5mm	303	420	562	534	356	345
Passing from	9.5mm	1508	1402	1537	1479	1078	991
Remaining on	9.5mm	303	374	268	404	158	318
Passing from	4.75mm	1188	1213	1196	1107	636	724
Remaining on	4.75mm	320	189	341	372	242	236
Corrosion%		32.3	34.06	35.4	32.45	24.89	27.41
Average		33.18		33.9		26.15	

Resource: The researchers

Which was calculated through the following equation:

Corrosion % = [(total weight of model - weight remaining on sieves / weight of model) * 100]---------------------- (4)

So, from the table (13) above, which was calculated based on the specifications (ASTM C 131), it is clear that the stone of the three sites varies in terms of the rate of corrosion, as well as the difference between the two models of one site, and this gives an indication of the strength of the cohesion and adhesion between the stone particles for the different sites. This separation is also an indicator of the density of the stone, as the higher the density of the stone, the lower the rate of corrosion, and the lower the rate of corrosion, the more this gives an indication of the quality of the stone and its uses, especially in finishes and parts of buildings exposed to moisture and erosion.

It is noted from Table (14) - the differences between the weights of the transient and the residual on each sieve. See Table (14), which contains real values for the sieve analysis process after the models are exposed to erosion through the Los Angeles device, which is used to measure the erosion that occurs as a result of friction between pieces of stone.

2-2-5: Sound Insulation:

It is the use of specific materials in the construction and finishing of homes that have the ability to prevent or reduce the appropriate sound level in the interior spaces of homes that require less insulation because they are often furnished. If there is a wall (24 cm) white and plastered on the inside and cement mortar on the outside, it is theoretically sufficient for sound insulation.

So how is sound intensity (Db) measured? It is measured in decibels through the equation below:

$$\mathbf{Dp= 10Log.(P_2/p_1)} \text{ --------------------------(5)}$$

When:

p_1 is sound intensity equal to the level equal to (10-16) watts/cm_2.

P_2 is current sound intensity (to which the wall is exposed) - watts/cm_2.

The walls are (12 cm) thick and produce (35-40) decibels, which can be sufficient in residential buildings.[15].

2-2-6: Heat Insulation:

It differs from one place to another (hot or cold environment, etc.) and also varies according to the type of material used in finishing the walls, ceilings and floors of the dwelling. The type of these materials is determined according to the degree of insulation required.

There are no materials in nature with complete insulation, but rather with relative insulation, and in fact they delay the transfer of heat. The lower the density of the material and the greater the percentage of voids in it, the greater its thermal insulation (the time delay for heat transfer increases). [16] .

So how do we proceed to control the heat inside the building?! Here it is necessary to know the medium through which heat is transferred:

1- If the medium is a conducting material, here it is necessary to control this material through terminations, then the process is a conducting.

2- If the medium is moving, such as air and water, then these means of heat transfer must be controlled.

3- There is another source of heat production, which is light and heat transfer by radiation.

Most of the thermal insulation materials are not locally manufactured, except for plaster, but some of them can be manufactured to provide their raw materials.

Stone is one of the natural materials that insulate heat and sound and are preferred in construction, especially finishes.

2-3: Summary of results:

From the results obtained from the laboratory analysis of the stones of the three sites, it was found that there are clear differences between them in terms of density, durability, absorption and erosion. These indicators lead us to determine which type is preferable for use based on the economic aspect, ease of use, and resistance to surrounding conditions, especially weather conditions. Table (15) represents a summary of the results obtained.

Table (15)

Summary of laboratory test results for stones in the three locations

Location	Density (Kg/m3)	Compressive strength (MPa)	Absorption (%)	Corrosion %	Sound Insulation db	Heat Insulation C
Kilo (60)	2305	26.02	4.0	33.18	40.3	11
Qaim	2119.33	26.60	3.46	33.9	43.5	10
Kubaisa	1760.3	21	7.47	26.15	60	18.4
Limits of the Iraqi standard (1387)	(1750-2150)	> 12	< 7.5	33	35	10

Resource: The researchers best to the Iraqi standard (1387)

The results showed that the physical properties of this material were (26.02, 26.6, and 23.3) MPa. For the sites (Kilo(60), Al-Qaim, and Kubaisa), respectively, in comparison with the Iraqi standard (1387), which specified the compressive strength for class (A) as (12 MPa). The density was (2305, 2120, and 1760) kg/m3 for the above sites, respectively. It is within the Iraqi standard, which specified (1750, 2150, and 2550) kg/m3 for the three types (A, B, and C). As for other specifications, such as absorption, fracture and corrosion criteria, they are within the limits of the Iraqi standard.

The research reached the possibility of using natural stone in construction works, especially housing in hot areas, due to its good nature in terms of standard physical properties.

This research is an introduction to studying environmental characteristics and their suitability in terms of insulation (acoustic and thermal) and pollution.

3: Conclusions and Recommendations:

3-1: Conclusions:

1-Through geological survey data for the study area, it was found that it contains a large reserve of stone that is suitable for use in construction

2-. Because the study area has a very large area, the stones varied in terms of their general characteristics. This gave the opportunity to study several regions and compare them in terms of their main physical characteristics.

3- There is a clear convergence in the density rate between the Al-Qaim and Ramadi areas (kilo 60), as the adjusted values for them were (2119 and 2305) kg/m^3, while the stone of the Kubaisa area gave a lower density rate (1760) kg/m^3, and this means that it is less weight and easy to use and shape. It is within the limits of the Iraqi standard (1387). It is (1750-2150) kg/m3.

4-In terms of compressive strength, similar results were also obtained between the Al-Qaim and Kilo 60 sites, as they were (26.6 and 26.02) megapascals, while the Kabisa site gave (21) megapascals. Which concludes that the above two locations are better in terms of compressive strength. All are higher than the Iraqi specification limits.

5-As for the water absorption property, everything is within the limits of the specification, as the results appear in Table (15), and the Iraqi standard specifies absorption to be less than (7.5%).

6-The stone of the study area has positive results in terms of the rate of corrosion, slightly higher than the Iraqi standard, which means that it is used with some finishing treatments, especially external ones.

7-The stone of the study area gave good results in terms of thermal and sound conduction, as it resulted in a significant reduction in sound, especially the Kabisa stone. Also, in terms of thermal conductivity, the value was given within the limits of the specification, and it is good in terms of insulation, as indicated in Table (15).

3-2: Recommendations:

1- Based on the results reached by the research in terms of physical properties, it gives the possibility of using this material in construction and finishing works based on these results and the presence of a large reserve of it and its spread in the region.

2- Stone is a natural material that was formed by geological and climatic conditions, which means that it is a natural material that is not greatly affected by these conditions, so it can be used widely.

3- Recommending to the responsible authorities and decision makers, directing the use of this material in building and construction works.

References:

[1] Al-Bayati, Ali Hussein and Al-Rawi, Muthanna, "Mineral composition of the soils of Anbar Governorate, identification of minerals separated by silt and clay," Al-Rafidain Agricultural Journal, Volume (32), Issue (1), 2002.
[2] Al-Rawi, Muthanna Khalil, "Characterization and distribution of parent materials for some sedimentary soils and their effect on soil characteristics," unpublished doctoral thesis, College of Agriculture, University of Baghdad, 2003.
[3] Tibor Buddy "the Regional Geology of Iraq" Vol.1, Baghdad, 1980. P.(268-286).
[4] (http://anamaamari.mam9.com/t270-topic
[5] Qadi, Talal bin Mustafa, "Industrial Minerals and Rocks," College of Earth Sciences, King Saud University, undated.P.(2).
[6] Sarsam, Jalal Bashir and Abdel-Aali, Saeed, "Construction Materials", Arabic Edition, Dar Al-Yazouri for Publishing and Distribution, Amman, Jordan, 2006.
[7] Qadi, Talal bin Mustafa, "Industrial Minerals and Rocks," College of Earth Sciences, King Saud University, undated.P.(4).
[8] Al-Kaflawi, Sami Abdel-Hussein, "Cracking and Collapse in Historical Buildings and Methods of Maintenance and Preservation," Publications of the General Authority for Antiquities and Heritage, Sumer Press, first edition, 2006. p. 99.
[9] Dr. Osama Abdel Nabi Qanbar, "Stone Construction Works (2)", published research, p. 5
[10] Qanbar, Osama Abdel-Ghani, (Stone Construction Works/2), research published on the website; http://www.scribd.com/doc/212263928/
11] Geological survey reports numbered (1320, 878, 802, 1426, 1862, 586, 943, 1023, 1510, 1566, 425, 326)
[12] Geological survey reports (1505, 669, 1073, 301, 304, 1421, 1779) and laboratory examination by researchers
[13] National Center for Structural Variants.
[14] American Code (ASTM)
[15] Al-Dawaf, Youssef, "Construction of Buildings and Building Materials," 2nd edition, Baghdad, 1976. P. 363.
[16] Al-Dawaf, Youssef, "Construction of Buildings and Building Materials," 6th edition, Offset Al-Zaman Press, Baghdad, 1982, p. 340.