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Influence of temperature on the prototypes made by earth bricks (raw and fired) reinforced with date palm fibers intended for constructions in the Saharan zone (Ouargla)

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Abstract

The building materials are the most used in the Algerian desert, concrete, cement mortar and brick, and these materials are characterized by weak thermal properties, knowing that the desert areas are characterized by a hot and dry climate in summer and cold in winter and within the framework of the valuation of local materials in order to contribute to reducing construction costs as well as energy consumption in air conditioning and heating was It is necessary to think about the exploitation of the existing resources in nature, which would contribute to reducing these burdens, as these materials are characterized by good thermal and mechanical properties. The aim of this article:

- A thermal and mechanical study of the evidence made of sand and clay according to the following percentages: 0%, 10%, 20%, 30% and 40% sand, and by adding palm fibers to the lubricants whose results were good and in the proportions of 1%, 2% and 3% of the weight of the blocks (bricks) And a thermal and mechanical study of roasted clay evidence, with ratios of 0% 1%, 2%, 3% fiber, 100%, 99%, 98%, 97% clay.
- As well as a thermal study and the extent of the effect of heat on the completed models with the pulp (bricks), so the results obtained indicate that the more we increased the fibers of these pulpins, they were thermally good and acceptable to some extent mechanically.

Keywords: Palm fibers, earth bricks, construction, thermal insulation. Prototypes mad, temperature deviation

1. Introduction

Since the first steps of man on earth, man has always known how to adapt to different elements, especially climatic (period of cold heat, precipitation). He has developed mechanisms, and tricks for his most comfortable life. Resulting from long and continuous experiences. Construction is part of these adaptations of man, the problem of thermal insulation is increasingly essential in ecological constructions consuming less energy. In Algeria, we are More and more interested in kind of construction, since the construction sector consuming about half of the total national energy production, in addition the efforts to trivialize in the supply of energy does not exceed 10 to 15%, which has led to the need to develop a strategy for effective control of energy consumption in the construction sector, where studies have shown that the use of thermal insulation can save about 40% of the energy consumed, c 'that is to say, saves about a quarter of national energy production. At the beginning of the sixties of the last century and especially after the world crisis, most of the industrialized countries continued the economic policy of energy and environmental protection, which led these countries to the evolution of the field of thermal insulation and the creation of laws and regulations on thermal insulation of buildings.

Algeria, like other developing countries, is affected by this problem, especially as it relies heavily on petroleum products which represent 98% of national income. And with the increasing global demand for energy and that this energy is not renewable, it must take serious measures to reduce the waste of energy, and also to innovate methods and materials which allows to reduce the consumption of energy. energy, in addition to trying to find new sources of renewable energy which translates into the need to make efforts in scientific research.This urged the Algerian state in 1998 to create laws to control energy consumption in buildings by achieving the following objectives:

- develop the energy efficiency of housing;
- Improve the thermal performance of buildings to have a natural balance and improve energy

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consumption in the future;

• Develop and evaluate local materials that have good thermal insulation; Energy consumption is high in southern Algeria, which is characterized by a desert climate, hot and dry in summer and intense cold in winter, the percentage of rainfall low. So the requirement to use thermal insulation systems for the contribution and to ensure thermal comfort to these residues from Saharan regions in such difficulties. In addition to saving electrical energy consumption.Thermal comfort in constructions is one of the concerns of interest to researchers in the field of construction, taking into account the economic aspect where there are many scientific research projects in the world on thermal comfort and construction materials.In Algeria, several building materials are used, including bricks, concrete blocks, plaster, etc., without any thermal study, especially in hot and dry regions (southern Algeria).

2. Completion of earth bricks

The experimental studies of our work consist in determining the thermal and mechanical characteristics of bricks fired in the traditional way by local clay, sand and datet palm fiber in dimensions (5.5x22x10.5) cm3[6]. There is an improvement in the thermal performance and mechanics of construction materials in the Saharan regions.

Preparation for samples used in the study For the preparation of bricks, we are the following

1. Weigh the clay;
2. Weigh the sand dunes;
3. Weigh the fibers;
4. Sook the clay until the saturation during 24h;
5. Add water of mixing;
6. Mix the ingredients manually;
7. Fill the molds with wood;
8. Dry the bricks in an opened area for 4 days;
9. Do a cooking for bricks in a traditional stove on 700°C temperature degrees timing 12h;
10. Present the cooked bricks.

Figure .1. Manual and electric mixing

The bricks (raw and fired) presented in the table below

Table 1.The ingredients used

Bricks	(%) Clay	(%) sand dunes	(%) Fiber
C1	100	0	0
C2	90	10	0
C3	80	20	0
C4	70	30	0
C5	60	40	0
CF1	**99**	**0**	**1**
CF2	**98**	**0**	**2**
CF3	**97**	**0**	**3**
CFc 1	100	**0**	0

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CFc 2	99	0	1
CFc 3	98	0	2
CFc 4	97	0	3

2.1. Experimental study of thermal and mechanical properties of earth bricks

Description of thermal conductivity measuring device:

CT-METER was developed with the aim of making it possible to evaluate with precision, the thermal characteristics of a certain number of homogeneous and isotropic materials. The operating principle consists, thanks to the association of a heating element and a temperature sensor (both associated in the same probe), in measuring the temperature rise undergone by the sensor, during a heating period chosen by the user according to the material to be tested and the type of probe
The CT-meter is made up of two elements which are the control unit, responsible for generating the heating power and interpreting the temperature rise curve induced in the material to be tested; and the probe responsible for transmitting the heating power and collecting the induced temperature. (NF in 993-15)

Figure .2 CT-meter

Four-point flexure test- NFP18- 407

The experiment is carried out on the building blocks that are used in the ceilings and roofs from the following materials: Concrete, scorched soil, polyester, gypsum by using a machine (type CONTROLS) as shown in the Figure 2 below, where the device is equipped with movable support (horizontal movement) below. The upper part has got a vertical motion where it is driven by hydraulic pressure (the experiment used is inspired by NFP18-407). The machine is provided with a solid piece of metal placed on top of the tested sample. The load is applied to the sample continuously at a speed of 0.5 kN / min until the sample collapses.

The value of the force leading to collapse is given directly from the machine. The tensile stress calculation relationship is given using the following relationship

$$\delta t = 3.F/2\alpha^2 \quad (1)$$

where:

F: Force applied to the sample.

α: The height of the tested sample

Figure .3 Four-point flexure test and Simple Compression Experience

Simple Compression Experience - Inspired by NFP18-406:

This experiment is carried out using the CONTROLS compression machine on raw and fired bricks,.

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The machine is equipped with two fixed lower plates and the upper mobile hydraulic pressure system where the sample is placed in their centers as shown in table 1. Both plates are square where a = 100mm. The load is applied to the sample continuously at a rate of 5 kN / min until the sample is exhausted. Reading of the value of the force leading to collapse collapses directly from the machine.

The relationship used in compression stress calculation:

$$\delta p=(F /S) \quad (2)$$

Where:

P: value of the force leading to the collapse of the sample.

S: Plate area supplied to the machine. Where S = 10000 mm.

This experiment is performed on the pure gypsum completed block using a machine of type (CONTROLS).

2.2. Specifications of models

After the measurements of thermal conductivity and on the basis that the unitsThermal measured per unit area, we made prototypes of 1mx1mx1m as follows and we take outside temperatures; Indoor T and humidity by digital thermometer and hygrometer on a hot day; and cold in order to enhance our bricks in construction we have produced some prototype made by bricks which exhibited good thermal properties during the month of August and December. The floors are chosen from the floors most used in construction. The models shown in the table below:

Table 2. The composition of the elements of the selected brick prototypes

Prototype	Tests	Floor Type
Model room P1	Carried out by the 15 cm red bricks witnesses	**concrete blocks covered**
Model room P2	Brick **CF2**	**concrete blocks covered**
Model room P3	Brick **CF3**	**concrete blocks covered**
Model room P4	Brick **CF1**	**concrete blocks covered**
Model room P (I)	Brick **CFc 1**	**concrete blocks covered**
Model room P (II)	Brick **CFc 2**	**concrete blocks covered**
Model room P (III)	Brick **CFc 3**	**concrete blocks covered**
Model room P (IV)	**Brick CFc 4**	**concrete blocks covered**

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Figure .4 the stages of model construction

3. Results and discussion

3.1. Thermal experiments

The results of measurement of thermal properties In the following, we detail the results for each thermal property.

The variation of thermal conductivity in addition to that of the function of the percentage of sand dunes and of the percentage of the fiber at the first time then do the thinnings al the second time Before measuring the thermal conductivity λ of our brick, we must use the CT-METER machine for this

Figures 5; 6 and 7 show thermal conductivity for earthen bricks (raw and fired)

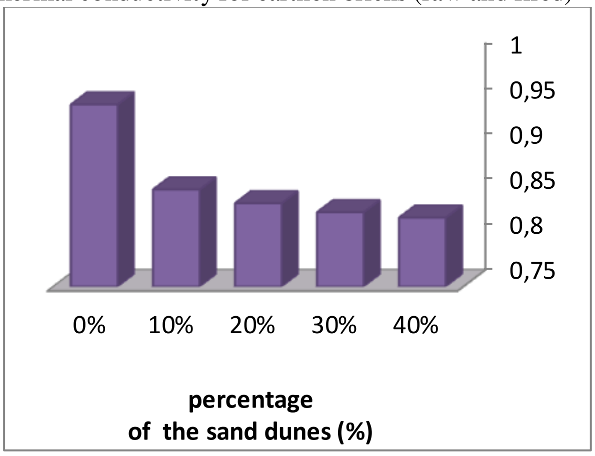

Figure .5 The Conductivity thermal λ (w/m.k) of the function of the percentage of the sand dunes

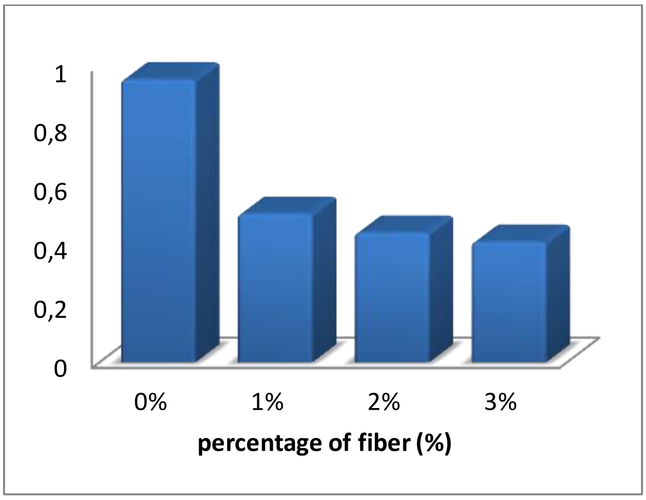

Figure .6 The Conductivity thermal λ (w/m.k) of the function of the percentage

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of the fiber (raw brick)

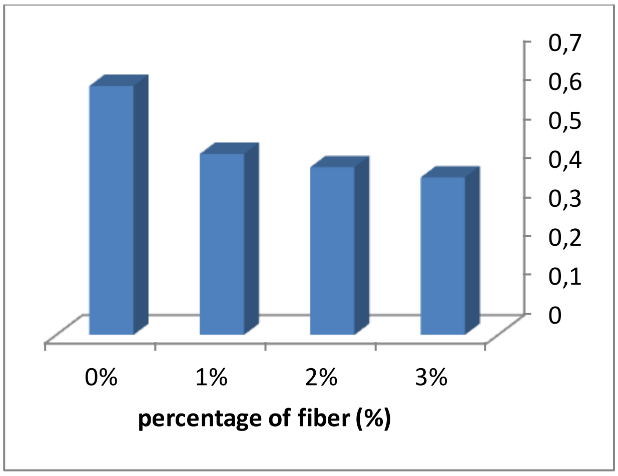

Figure .7 The Conductivity thermal λ (w/m.k) fired bricks

3.2. Mechanical experiments

Result of measurement of the mechanical properties Rc = Fc / S RC: Resistance to compression expressed in MPa. FC: Maximum load supported by the test piece in N. S: the cross-section of the test piece (s = axb) mm²

The results of the compression experiment for mud bricks are shown.the Resistances in (MPa) at 28 days in Table 3;4 and 5

Table 3. Variation of flexural and compressive strengths for clay bricks and dune sand

briks	R_f in MPa	R_c in MPa
C1	0.412±0.04	1,800±0.10
C2	0.515±0.03	1,94±0.15
C3	0.61±0.12	2,01±0.18
C4	0.66±0.07	2,412±0.13
C5	0.698±0.06	2,8100±0.17

From table 3, it's noted that both the tensile stress and the compressive stress rise as the value of force applied

Table 4. Variation of flexural and compressive strengths for clay and fiber mud bricks

bricks	R_f in MPa	R_c in MPa
C1	0.418±0.04	1,800±0.10
CF1	0,747±0.03	2,845±0.17
CF2	0.832±0.11	3,234±0.13
CF3	1,176±0.07	3,523±0.11

From table 4, it's noted that both the tensile stress and the compressive stress rise as the value of force applied

Tabl 5. Variation of flexural and compressive strengths for clay and fiber fired bricks

bricks	R_f in MPa	R_c in MPa
CFc 1	2,845±0.14	4,53 ±0.18
CFc 2	2,12±0.13	4,38±0.19

CFc 3	1,823±0.16	4,123±0.10
CFc 4	1,445±0.27	2,65 ±0.16

From table 5, it is noted that the tensile stress and the compressive stress decreasing with the value of the applied force

4. Results of experiments carried out in the rooms

We point out, that this experiment was carried out during the hotter month and the colder month. Are the months of August and the month of December; at the EVRNZA Laboratory located at Kasdi Merbah University 2015

4.1. Temperature evolution during the summer and winter days of the rooms models

According to the recommendations of the Algerian DTR Thermal Building Regulations C3.2 and C3.4, [17] the requirement for summer and winter hygrothermal comfort for humidity varies between 30% and 60% are: T comfort Min = 24 ° C, T comfort T Max = 30 ° C.

Using a digital thermometer and hygrometer, we measured the climatic data Note: we have chosen the days of 02 and 03-08-2015; these are the hottest days and the days of 22 and 23-12-2015; it is the coldest days according to the weather services The results obtained are shown in Figures 8 and 9

1. Temperature and humidity during a summer day

Results of the experiments carried out on the rooms

Figures 8 and 9 summarizes the evolution of outdoor temperature and indoor humidity

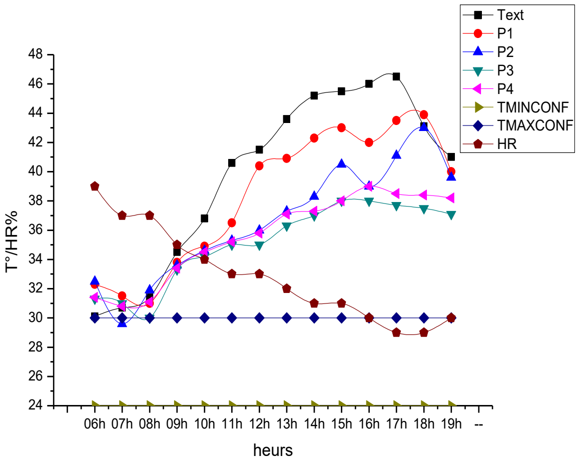

Figure .8. The temperature and humidity evolution of the summer day for the room P 1 to P 4 prototypes

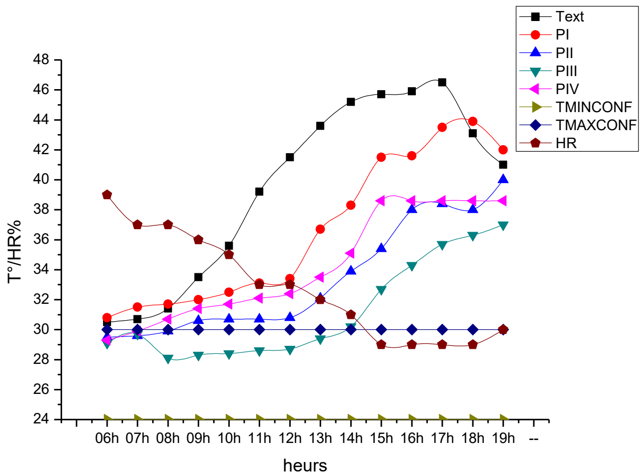

Figure .9 The temperature and humidity evolution of the summer day for the room P (I) to P (IV)

Model room P1

Shows the evolution of internal and external temperature and humidity according to the hours of the day.The indoor temperature increases from 30.8 ° C to 44.5 ° C as the outdoor temperature increases from 30.5 ° C to 46.5 ° C. A slight decrease is observed at 6 p.m. but we recorded an increase in the internal temperature despite the decrease in the outside temperature. This is due to the heat storage effect of the concrete slab which influences this increase. Concrete stores heat and releases it gradually. So there was an amplification of the temperature inside the prototype (thermal oven effect). In addition, the use of air conditioners almost never stops and this is reflected in the consumption of electrical energy.

On the other hand, humidity is reduced with the increase in temperature

Model room P2

Shows the evolution of internal and external temperature and humidity according to the hours of the day The interior temperature increases from 29.5 ° C to 38 ° C following the increase outdoor temperature from 30.5 ° C to 46.5 ° C. A slight decrease is observed at 6 p.m. but we recorded an increase in the internal temperature despite the decrease in the outside temperature. This is due to the effect of heat storage by the walls and floor which influences this increase. Concrete stores heat and releases it gradually. So there was an amplification of the temperature inside the prototype (oven effect) on the other hand Deprived of humidity with the increase in temperature

Model room P3

Shows the evolution of internal and external temperature and humidity according to the hours of the day The indoor temperature varies from 29.1 ° C to 33.7 ° C following the increase in outdoor temperature from 30.5 ° C to 46.5 ° C. But after 5:00 p.m. it stabilizes around 34 ° C despite the outside temperature exceeding 40 ° C. However, the internal temperature remains within the thermal comfort range. So we can say that there is a very large temperature phase shift between the outside and the inside. This prototype is beneficial from a thermal point of view. and this means that it is necessary to use the air conditioners after 02:00 pm and at 05:00 p m hours the internal temperature stabilizes or approximately 35 ° C. This model can be seen as a good one, and that the temperature does not exceed 30 ° C - the thermal comfort range extended from 6:00 am until 02:00.p m

On the other hand, humidity is reduced with the increase in temperature

Model room P4

Shows the evolution of internal and external temperature and humidity according to the hours of the day The interior temperature increases from 29.3 ° C to 38,6 ° C following the increase

outdoor temperature from 30.5 ° C to 46.5 ° C. A slight decrease is observed at 6 p.m. Shows the change in the internal and external temperatures and humidity in terms of the hours of the day. It is noticed that there is a direct correlation between the rise in the internal and external temperature, where the higher the external temperature is, the higher the internal one gets. What is also observed in this model is that the internal temperature since 8:00 am in the morning exceeds 30 ° C .which means that the air conditioner must be used and this has an effect on the consumption of electrical energy. The field of thermal comfort is achieved from 06:00 until 08:00p m. On the other hand deprived of humidity with the increase in temperature

Model room P (I)

This is due to the effect of heat storage by the concrete slab which influences this increase. Concrete stores heat and releases it gradually. So there was an amplification of the temperature inside the prototype. As the RH humidity decreases according to the increase in temperature.

Model room P (II)

We recorded a slight difference between the outdoor and indoor temperature of (3 to 4) 0C from 7am to 8am, a clear temperature difference was recorded from (4 to 7) 0C during the period between 8am to 6pm. This is explained by the resistance of the wall brick samples to heat. The temperature is maintained at 6:00 p.m., the phenomenon becomes the opposite.

At the moment that the RH humidity deprived with the increase in temperature.

Model room P(III)

This is due to the effect of the heat storage by the concrete slab which influences this increase. The heated slab stored heat during the day from 12 p.m. to 5 p.m. And after the absence of solar radiation, heat is released from the warmer environment to the colder environment. Concrete stores heat and release it gradually. So there was an amplification of the temperature inside the prototype.
At the moment that the humidity deprived with the increase in temperature.

Model room P(IV)

This has a direct relationship with the materials used in the construction of the elements of this prototype which do not retain heat. From 2:00 p.m., we recorded a thermal difference of 4 to 5 ° C. It comes down to

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the resistance of terracotta bricks against the sun's rays. In this type of construction, we can only use air conditioning from 5:00 p.m. in order to save electricity.

As the humidity decreases with the increase in temperature

- So we can say that some prototypes can reduce

The internal temperature by acceptable variations which can reach 14 ° C. there is a significant difference in temperature between the exterior and the interior where the heat, which is transmitted by radiation, has undergone considerable damping.

The model room that fall within the comfort range are:

P(III) until 2 p.m. This highlights the efficiency of the slabs and also the efficiency of the bricks, especially those reinforced with 3% palm fibers.

2. Temperature and humidity during a winter day

figure 10 and 11 summarizes the evolution of outside and inside temperature for the P1, P2, P3, P4 prototypes used. We took the measurements on 22-12-2015 on the day recommended by the weather services as being statistical on the coldest day of the year

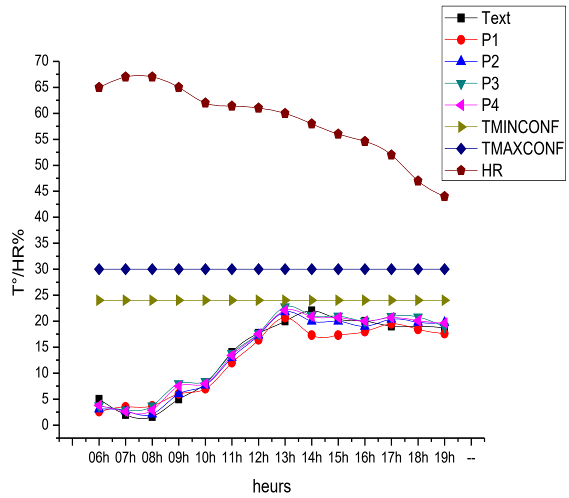

Figure .10 . The temperature and humidity evolution of the winter day for the room P 1 to P 4

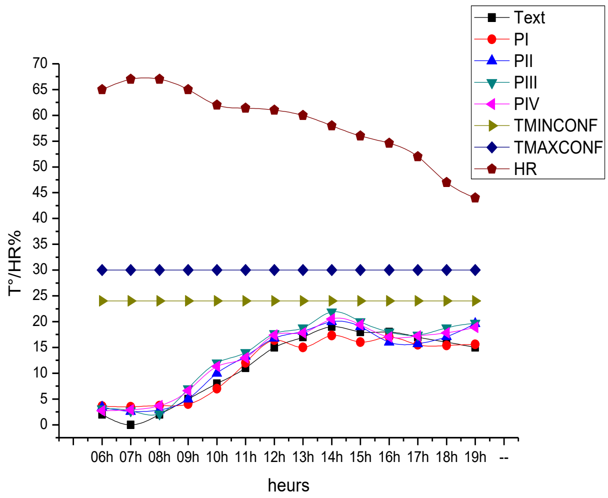

Figure .11 The temperature and humidity evolution of the winter day for the room P (I) to P (IV)

From figures 10 and 11 we notice the following points:

Model room P1

The indoor temperature increases from 2.6 ° C to 20.7 ° C from 6 a.m. to 1 p.m. following the increase in outdoor temperature from 5 ° C to 22 ° C. A slight decrease is observed at 7 p.m. This is due to the effect of heat transfer through the concrete slab which influences this increase. Concrete stores cold like heat and releases them gradually. So there was a storage of the temperature inside the prototype (oven effect)

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On the other hand the humidity RH% decreases with the increase of temperature where the degree of humidity outside is from 67% to 44% during the whole period of the practice, these results are in the range of thermal comfort by relative to humidity (30% to 60%), its influence is positive when the temperature is between 24 ° C and 30 ° C.

Model room P2

The indoor temperature varies from 3.8 ° C to 21.1 ° C from 6 a.m. to 1 p.m. following the increase in outdoor temperature from 5 ° C to 22 ° C. But after 1 p.m. it stabilizes around 19 ° C although the outside temperature decreases

Or the humidity RH% decreases with the increase in temperature where the degree of humidity outside is 67% to 44% during the whole period of the practice, these results are in the range of thermal comfort compared to humidity (30% to 60%), its influence is positive when the temperature is between 24 ° C and 30 ° C.

Model room P3

The indoor temperature varies from 3.1 ° C to 22.7 ° C following the increase in outdoor temperature from 5 ° C to 22 ° C. But after 2 p.m. it stabilizes at around 19 ° C although the outside temperature after this time drops out, the internal temperature remains in the thermal comfort range. We can say that there is a very important temperature difference between the outside and the inside. This prototype is beneficial from a thermal point of view. On the other hand the humidity RH% decreases with the increase of temperature where the degree of humidity outside is from 67% to 44% during the whole period of the practice, these results are in the range of thermal comfort by relative to humidity (30% to 60%), its influence is positive when the temperature is between 24 ° C and 30 ° C.

Model room P4

The indoor temperature increases by 3.7 ° Ca 22.6 ° C as the outdoor temperature increases from 5 ° C to 22 ° C. But after 2 p.m. it stabilizes around 18 ° C although the outside temperature is poor. On the other hand the humidity RH% decreases with the increase of temperature where the degree of humidity outside is from 67% to 44% during the whole period of the practice, these results are in the range of thermal comfort by relative to humidity (30% to 60%), its influence is positive when the temperature is between 24 ° C and 30 ° C.

Model room P (I)

The indoor temperature increases by 2.6 ° Ca 20.6 ° C as the outdoor temperature increases from 5 ° C to 20 ° C. But after 2 p.m. it stabilizes around 18 ° C despite the fact that the outside temperature will drop. This is due to the effect of heat storage by the concrete slab which influences this increase. Concrete stores heat and releases it gradually. So there was an amplification of the temperature inside the prototype. Humidity RH decreases with increasing temperature.

Model room P(II)

The indoor temperature increases by 3.1 ° Ca 23.6 ° C as the outdoor temperature increases from 5 ° C to 20 ° C. But after 2 p.m. it stabilizes around 18 ° C despite the fact that the outside temperature will drop. This is due to the effect of heat storage by the concrete slab which influences this increase. Concrete stores heat and releases it gradually. So there was an amplification of the temperature inside the prototype. Humidity RH decreases with increasing temperature.

Model room P(III)

The indoor temperature increases by 3.7 ° Ca 22.6 ° C as the outdoor temperature increases from 5 ° C to 20 ° C. But after 2 p.m. it stabilizes around 18 ° C despite the fact that the outside temperature will drop. This is due to the effect of heat storage by the concrete slab which influences this increase. Concrete stores heat and releases it gradually. So there was an amplification of the temperature inside the prototype.

Humidity RH decreases with increasing temperature.¬

Model room P(IV)

The indoor temperature increases by 3.8 ° Ca 23.2 ° C as the outdoor temperature increases from 5 ° C to 20 ° C.¬ But after 2 p.m. it stabilizes around 18 ° C despite the fact that the outside temperature will drop. This is due to the effect of heat storage by the terracotta slab which influences this increase. Indeed the terracotta slabs stores heat and releases it gradually. So there was an amplification of the temperature inside the prototype.

Humidity RH decreases with increasing temperature

We can say that the walls of some prototypes have significant thermal resistance seen in the results obtained. So there is a significant deference of temperature reduction between the exterior and the interior where the heat flow, which is transmitted by heat transfer has undergone considerable damping.

The prototypes that enter the thermal comfort range are:

P (III) until 2 p.m. This demonstrated the effectiveness of the bricks, especially those reinforced with palm

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fibers of the percentage indicated.

3. Summer and winter Variation of the internal and external temperature in the room

To better see the influence of prototypes on the decrease in indoor temperature we will present in figures 12;13;14 and 15 the temperature differences between outside and inside

1 - Variation of the internal and external temperature in the room in Summer day:

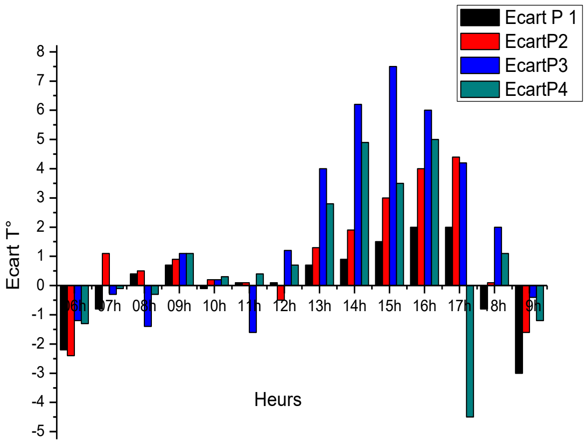

Figure 12. Variation of the internal and external temperature in the room in Summer day

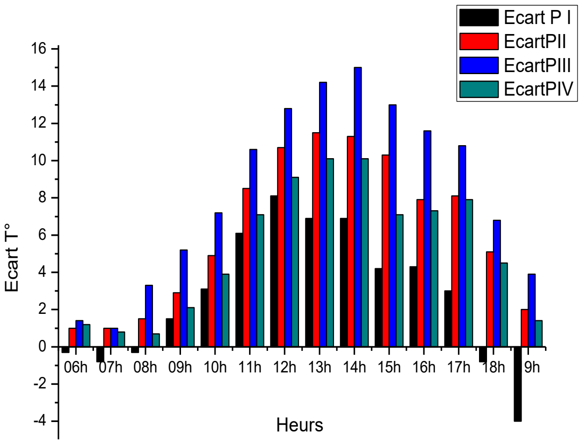

Figure 13. Variation of the internal and external temperature in the room in Summer day

From figures 12 and 13 we notice the following points:

Model room P1

shows the difference between internal and external temperatures during the day. It is found that during the first hours, the temperature inside is higher than outside because the walls (walls and floors) absorb and store heat during the day and without solar radiation it begins to lose heat. (thermal equilibrium of the hot medium towards the cold medium). But from 12 noon to 5 p.m., the outside temperature remains higher inside (the effect of the sun). After 5:00 p.m., the opposite becomes the reason mentioned above and it is a heat store for construction elements (slabs and walls). In this model, the temperature difference reaches about 3 and this is due to the walls in salary (containing voids)

Model room P2

shows the difference between internal and external temperatures during the day. It is found that during the first hours, the temperature inside is higher than outside because the walls (walls and floors) absorb and store heat during the day and without solar radiation it begins to lose heat. (thermal equilibrium of the hot medium towards the cold medium). But from 12 noon to 5 p.m., the outside temperature remains higher inside (the effect of the sun). After 5:00 p.m., the opposite becomes the reason mentioned above and it is a heat store for

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construction elements (slabs and walls). In this model, the temperature difference reaches about 3 and this is due to the walls in salary (containing voids)

Model room P3

shows the difference between internal and external temperatures during the day. It is found that during the first hours, the temperature inside is higher than outside because the walls (walls and floors) absorb and store heat during the day and without solar radiation it begins to lose heat. (thermal equilibrium of the hot medium towards the cold medium). But from 12 noon to 5 p.m., the outside temperature remains higher inside (the effect of the sun). After 5:00 p.m., the opposite becomes the reason mentioned above and it is a heat store for construction elements (slabs and walls). In this model, the temperature difference reaches about 15 and this is due to the walls in salary (containing voids)

Model room P4

shows the difference between internal and external temperatures during the day. It is found that during the first hours, the temperature inside is higher than outside because the walls (walls and floors) absorb and store heat during the day and without solar radiation it begins to lose heat. (thermal equilibrium of the hot medium towards the cold medium). But from 12 noon to 5 p.m., the outside temperature remains higher inside (the effect of the sun). After 5:00 p.m., the opposite becomes the reason mentioned above and it is a heat store for construction elements (slabs and walls). In this model, the temperature difference reaches about 10.1 and this is due to the walls in salary (containing voids)

Model room P (I)

shows the difference between internal and external temperatures during the day. It is found that during the first hours, the temperature inside is higher than outside because the walls (walls and floors) absorb and store heat during the day and without solar radiation it begins to lose heat. (thermal equilibrium of the hot medium towards the cold medium). But from 12 noon to 5 p.m., the outside temperature remains higher inside (the effect of the sun). After 5:00 p.m., the opposite becomes the reason mentioned above and it is a heat store for construction elements (slabs and walls). In this model, the temperature difference reaches about 8 and this is due to the walls in salary (containing voids)

Model room P(II)

shows the difference between internal and external temperatures during the day. It is found that during the first hours, the temperature inside is higher than outside because the walls (walls and floors) absorb and store heat during the day and without solar radiation it begins to lose heat. (thermal equilibrium of the hot medium towards the cold medium). But from 12 noon to 5 p.m., the outside temperature remains higher inside (the effect of the sun). After 5:00 p.m., the opposite becomes the reason mentioned above and it is a heat store for construction elements (slabs and walls). In this model, the temperature difference reaches about 11.5 and this is due to the walls in salary (containing voids)

Model room P (III)

shows the difference between internal and external temperatures during the day. It is found that during the first hours, the temperature inside is higher than outside because the walls (walls and floors) absorb and store heat during the day and without solar radiation it begins to lose heat. (thermal equilibrium of the hot medium towards the cold medium). But from 12 noon to 5 p.m., the outside temperature remains higher inside (the effect of the sun). After 5:00 p.m., the opposite becomes the reason mentioned above and it is a heat store for construction elements (slabs and walls). In this model, the temperature difference reaches about 14.8 and this is due to the walls in salary (containing voids).

Model room P (IV)

shows the difference between internal and external temperatures during the day. It is found that during the first hours, the temperature inside is higher than outside because the walls (walls and floors) absorb and store heat during the day and without solar radiation it begins to lose heat. (thermal equilibrium of the hot medium towards the cold medium). But from 12 noon to 5 p.m., the outside temperature remains higher inside (the effect of the sun). After 5:00 p.m., the opposite becomes the reason mentioned above and it is a heat store for construction elements (slabs and walls). In this model, the temperature difference reaches about 10.2 and this is due to the walls in salary (containing voids)

2 - Variation of the internal and external temperature in the room in winter day in temperature

From figures 14 and 15 we notice the following points:

Model room P1

shows the difference between internal and external temperatures during the day. It is noted that during the first hours, the temperature inside is lower than outside because the walls (walls and floors) absorb and store the cold during the night it begins to lose heat. (thermal equilibrium of the cold medium towards the hot medium). But from 12 p.m. to 4 p.m., the outside temperature remains lower inside (slabs and walls). After 5:00 p.m., the opposite becomes the reason mentioned above and it is a heat accumulator for the building elements (effect of the sun). In this model, the temperature difference reaches about 4.7 and it is because of the effect of the thermal furnace where good greenhouse effect so there was an increase in

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temperature inside

Model room P2

shows the difference between internal and external temperatures during the day. It is noted that during the first hours, the temperature inside is lower than outside because the walls (walls and floors) absorb and store the cold during the night it begins to lose heat. (thermal equilibrium of the cold medium towards the hot medium). But from 12 p.m. to 4 p.m., the outside temperature remains lower inside (slabs and walls). After 5:00 p.m., the opposite becomes the reason mentioned above and it is a heat accumulator for the building elements (effect of the sun). In this model, the temperature difference reaches about 2.8 and it is because of the effect of the thermal furnace where good greenhouse effect so there was an increase in temperature inside

Model room P3

shows the difference between internal and external temperatures during the day. It is noted that during the first hours, the temperature inside is lower than outside because the walls (walls and floors) absorb and store the cold during the night it begins to lose heat. (thermal equilibrium of the cold medium towards the hot medium). But from 12 p.m. to 4 p.m., the outside temperature remains lower inside (slabs and walls). After 5:00 p.m., the opposite becomes the reason mentioned above and it is a heat accumulator for the building elements (effect of the sun). In this model, the temperature difference reaches about 2 and it is because of the effect of the thermal furnace where good greenhouse effect so there was an increase in temperature inside

Model room P4

shows the difference between internal and external temperatures during the day. It is noted that during the first hours, the temperature inside is lower than outside because the walls (walls and floors) absorb and store the cold during the night it begins to lose heat. (thermal equilibrium of the cold medium towards the hot medium). But from 12 p.m. to 4 p.m., the outside temperature remains lower inside (slabs and walls). After 5:00 p.m., the opposite becomes the reason mentioned above and it is a heat accumulator for the building elements (effect of the sun). In this model, the temperature difference reaches about 2.6 and it is because of the effect of the thermal furnace where good greenhouse effect so there was an increase in temperature inside

This is why we can classify the prototypes on the comfort side as follows: P 3; P 2; P 4 and P 1

Model room P4(I)

shows the difference between internal and external temperatures during the day. It is noted that during the first hours, the temperature inside is lower than outside because the walls (walls and floors) absorb and store the cold during the night it begins to lose heat. (thermal equilibrium of the cold medium towards the hot medium). But from 12 p.m. to 4 p.m., the outside temperature remains lower inside (slabs and walls). After 5:00 p.m., the opposite becomes the reason mentioned above and it is a heat accumulator for the building elements (effect of the sun). In this model, the temperature difference reaches about 4.7 and it is because of the effect of the thermal furnace where good greenhouse effect so there was an increase in temperature inside

Model room P (II)

shows the difference between internal and external temperatures during the day. It is noted that during the first hours, the temperature inside is lower than outside because the walls (walls and floors) absorb and store the cold during the night it begins to lose heat. (thermal equilibrium of the cold medium towards the hot medium). But from 12 p.m. to 4 p.m., the outside temperature remains lower inside (slabs and walls). After 5:00 p.m., the opposite becomes the reason mentioned above and it is a heat accumulator for the building elements (effect of the sun). In this model, the temperature difference reaches about 2.9 and it is because of the effect of the thermal furnace where good greenhouse effect so there was an increase in temperature inside

Model room P (III)

shows the difference between internal and external temperatures during the day. It is noted that during the first hours, the temperature inside is lower than outside because the walls (walls and floors) absorb and store the cold during the night it begins to lose heat. (thermal equilibrium of the cold medium towards the hot medium). But from 12 p.m. to 4 p.m., the outside temperature remains lower inside (slabs and walls). After 5:00 p.m., the opposite becomes the reason mentioned above and it is a heat accumulator for the building elements (effect of the sun). In this model, the temperature difference reaches about 2.7 and it is because of the effect of the thermal furnace where good greenhouse effect so there was an increase in temperature inside

Model room P (IV)

shows the difference between internal and external temperatures during the day. It is noted that during the first hours, the temperature inside is lower than outside because the walls (walls and floors) absorb and store the cold during the night it begins to lose heat. (thermal equilibrium of the cold medium towards the hot medium). But from 12 p.m. to 4 p.m., the outside temperature remains lower inside (slabs and walls). After 5:00 p.m., the opposite becomes the reason mentioned above and it is a heat accumulator for the building elements (effect of the sun). In this model, the temperature difference reaches about 2.8 and it is because of the effect of the thermal furnace where good greenhouse effect so there was an increase in temperature inside

This is why we can classify the prototypes on the comfort side as follows:

P(III);P(II) ;P(IV) and P(I)

5. Conclusion

Through to the experimental study, it turns out that the building bricks made from the burnt soil are suitable in our desert buildings, because their thermal resistance is good in addition to their availability in the market. The fact that the date palumer fiber building bricks which have their thermal resistance are the largest among the tested building bricks and that they have a very light weight, which only reflects, even with the dimensions of the elements slab carriers, and this has an economic effect, except that their lack of presence in the market also has a financial impact. As recommendations in this article, the following should be considered:

Building materials: As local building materials as possible should be used. (Use stones and make sure they are bonded to the following materials: odor, lime, clay, or use of mud and fired bricks reinforced with palm fibers). Resistant materials and bioclimatic.For this reason, the housing is oriented to the south-east to take advantage of the sunlight in winter and protect itself from the summer.The land is a ecological material par excellence, so that we can exploit and enhance the natural deceased (palm fiber) and construction we see an improvement in thermal performance and mechanics of building materials in the Saharan regions. , the architectural model must be adapted to the dry and hot climate, which makes it possible to foresee a minimum of solar gain in summer and heat loss in winter.

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