

## EXPERIMENTAL STUDY ON STRENGTH BEHAVIOR OF BRICKS USING ADMIXTURES

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**ABSTRACT:** A brick is a building material used to make walls, pavements and other elements in masonry construction. Admixtures are added into the clay soil to increase the strength variation of bricks such as jaggery, palm jaggery, soap nut. Which are used in required proportions as follows. Jaggery and ordinary water is mixed with the required proportions such as 60ml, 100ml, 200ml, and 300ml with clay soil. Palm jaggery and ordinary water is mixed with the required proportions such as 60ml, 100ml, 200ml, and 300ml with clay soil. Soap nut and ordinary water is mixed with the required proportions such as 60ml, 100ml, 200ml, and 300ml with clay soil. Jaggery, palm jaggery, soap nut is mixed with required proportions such as 60ml, 100ml, 200ml and 300ml with clay soil. Each of the above required proportioned brick is conducting the following tests. Compressive strength Test, Water absorption Test, Efflorescence test, Soundness test then the compressive strength of distinct proportions is found by the experimental studies. Results shows by the comparative of compressive strength of bricks with normal and adding of admixtures for strength variation of bricks.

**Keywords:** Jaggery, Palm jaggery, Soap nut, Proportions, Tests.

### I. INTRODUCTION

A brick is building material used to make walls, pavements and other elements in masonry construction. Traditionally, the term brick referred to a unit composed of clay, but it is now used to denote any rectangular units lay in mortar. A brick can be composed of clay-bearing soil, sand, and lime, or concrete materials. Bricks are produced in numerous classes, types, materials, and sizes which vary with region and time period, and are produced in bulk quantities. Two basic categories of bricks are fired and non-fired bricks.



BRICK

A brick is a rectangular in shape and of size that can be convenient to handle with one hand. Brick may be made of burnt clay or mixture of sand and lime or of fly ash lime and sand or of Portland cement concrete. Clay bricks are commonly used since these are economical and easily available.

### II. ADMIXTURES

Admixtures are added into the clay soil to improve the strength variations of bricks. So following admixtures used in the preparation of clay soil are

- JAGGERY
- PALM JAGGERY
- KADUKKAAI

#### JAGGERY

The scientific or technical definition of jaggery is an amorphous form of unrefined and non-distilled sugar prepared from the sap or the juice of plants that contains a considerable amount of sucrose or sugar. This includes things like sugarcane and certain palms like date palm and palmyra. This jaggery is fermented for one day and 25gms of jaggery is mixed with 1 liter of water.



Fig:11- JAGGERY

#### PALM JAGGERY

It is made from the extract of palm trees. The process of making Jaggery from the plant sources, doesn't involve any chemical agents and hence all the natural minerals salts are retained without adding any preservatives of chemicals. This Palm Jaggery is fermented for one day and 25gms of jaggery is mixed with 1 liter of water.



Fig:12-PALM JAGGERY

#### Kadukkai

Kadukkai is a fruit from a tree called "Terminalia Chebula". The fruit is small and ribbed. We call it "Kadukkai" in Tamil & English. Kadukkai is called "Sarvoraga Nivarani" in Ayurveda meaning it is a universal medicine. Kadukkai is

used as a medicine for many diseases in India . Kadukkai is fermented for 3 days to 7 days and 100gms of kadukkai is mixed with 1 liter of water.



Fig:13- KADUKKAI

### III. MIX PROPORTIONING OF ADMIXTURES

In this present work, the main object is to resolve the behavior of bricks in compression by adding kadukkai, Jaggery, palm jaggery and jaggery waste as admixtures into the bricks. This Jaggery is fermented for one day and 25gms of jaggery is mixed with 1 liter of water. Kadukkai is fermented for 3 days to 7 days and 100gms of kadukkai is mixed with 1 liter of water. Jaggery waste is mixed with some amount of clay. Palm Jaggery is fermented for one day and 25gms of jaggery is mixed with 1 liter of water

#### 3.1 Jaggery and Ordinary Water

25gms of jaggery is mixed with 1000ml of water. The jaggery is fermented for one day. Jaggery and ordinary water mixed with clay soil in the ratio of 60ml, 100ml, 200ml, and 300ml.

50gms of jaggery is mixed with 1000ml of water. The jaggery is fermented for one day. Jaggery and ordinary water mixed with clay soil in the ratio of 60ml, 100ml, 200ml, and 300ml.

100gms of jaggery is mixed with 1000ml of water. The jaggery is fermented for one day. Jaggery and ordinary water mixed with clay soil in the ratio of 60ml, 100ml, 200ml, and 300ml.

#### 3.2 Palm Jaggery and Ordinary Water

25gms of Palm jaggery is mixed with 1000ml of water. The Palm jaggery is fermented for one day. Palm Jaggery and ordinary water mixed with clay soil in the ratio of 60ml, 100ml, 200ml, and 300ml.

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#### 3.3 Jaggery and Kadukkai Water

25gms of Jaggery and kadukkai is mixed with 1000ml of water. The kadukkai is fermented for seven days. Jaggery, water and kadukkai water mixed with clay soil in the ratio of 60ml, 100ml, 200ml, and 300ml.

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#### 3.4 Palm jaggery and kadukkai water

25gms of Palm jaggery and kadukkai is mixed with 1000ml of water. The kadukkai is fermented for seven days. Palm Jaggery water and kadukkai water mixed with clay soil in the ratio of 60ml, 100ml, 200ml, and 300ml.

50gms of Palm jaggery and kadukkai is mixed with 1000ml of water. The kadukkai is fermented for seven days. Palm Jaggery water and kadukkai water mixed with clay soil in the ratio of 60ml, 100ml, 200ml, and 300ml.

100gms of Palm jaggery and kadukkai is mixed with 1000ml of water. The kadukkai is fermented for seven days. Palm Jaggery water and kadukkai water mixed with clay soil in the ratio of 60ml, 100ml, 200ml, and 300ml.

#### 3.5 Jaggery and palm jaggery with kadukkai water

25gms of Jaggery, Palm jaggery and kadukkai is mixed with 1000ml of water. The kadukkai is fermented for seven days. Jaggery and Palm Jaggery water and kadukkai water mixed with clay soil in the ratio of 60ml, 100ml, 200ml, and 300ml.

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## IV. PREPARATION OF BRICKS

### 4.1 PREPARATION OF CLAY

In this present work, the main object is to resolve the behavior of bricks in compression by adding kadukkai, Jaggery, palm jaggery and jaggery waste as admixtures into the bricks. This Jaggery is fermented for one day and 25gms of jaggery is mixed with 1 liter of water. Kadukkai is fermented for 3 days to 7 days and 100gms of kadukkai is mixed with 1 liter of water. Jaggery waste is mixed with some amount of clay. Palm Jaggery is fermented for one day and 25gms of jaggery is mixed with 1 liter of water As per quantity of clay soil taken. Add a Admixture of Jaggery, Palm Jaggery water and Jaggery waste in a different ratio of 60ml, 100ml, 200ml, and 300ml into the clay soil. Add Kadukkai water as per ratio into the clay soil. Then use hand or leg tempering the clay. Proper mix is essential.



Fig:1 -Preparation Of Clay For Brick

#### 4.2 MOULDING OF BRICKS

Moulding of the bricks into the proper shape and size can be done manually with the hands or it can be done with the help of machines. Hand moulding can take more time as compare to the machine moulding. Hand moulding is employed when the cheap labor available to us and less numbers of bricks are required to be manufactured and machine moulding can be employed when the labor is costly and the large numbers of bricks are required. Machine moulding is more accurate than the hand moulding. After the Clay with admixture is ready for moulding. The Sand is spread into the floor before moulding. Pour the clay in half portion of mould and press downward. Likewise the remaining clay is put into the mould consider the all corners. Then finally finishing should be made on moulded clay. After that finishing process mould can remove upward and frog is drawn on the moulded clay.

After molding process the bricks contain some amount of moisture in it. So, drying is to be done otherwise they may cracked while burning. The drying of raw bricks is done by natural process. The bricks are laid in stacks. A stack consists 8 to 10 stairs. The bricks in these stacks should be arranged in such a way that circulation of air in between the bricks is free. The period of drying may be 3 to 10 days. It also depends upon the weather conditions. The drying yards are also prepared on higher level than the normal ground for the prevention of bricks from rain water. In Some situations artificial drying is adopted under special dryers or hot gases. After the moulding process the moulded clay soil is dry it for half day in the position. After half day turn the brick and finishes should be done. Then it will allow for dry 1day in the position. After 1 day the moulded bricks are arrange in a window position. In summer season it will dry in 7 days. In winter season it will dry in 15 days.

#### 4.3 BURNING OF BRICKS

In the process of burning, the dried bricks are burned either in clamps (small scale) or kilns (large scale) up to certain degree temperature. In this stage, the bricks will gain hardness and strength so it is important stage in manufacturing of bricks. The temperature required for burning is about 1200°C. If they burnt beyond this limit they

will be brittle and easy to break. If they burnt under this limit, they will not gain full strength and there is a chance to absorb moisture from the atmosphere. Hence burning should be done properly to meet the requirements of good brick.



Fig:2-BURNING OF BRICKS

#### V. TESTING ON BRICKS WITH ADMIXTURES

It is necessary to check the quality of brick before using it in any construction activities. There are some field tests that we can conduct in the field in order to check the quality of bricks. These tests are as follows.

- Compression strength test
- Water absorption test
- Efflorescence test
- Soundness test

##### 5.1 Compressive strength test

Unevenness observed in the bed faces of bricks is removed to provide two smooth and parallel faces by grinding. It is immersed in water at room temperature for 24 h. The specimen is then removed and any surplus moisture is drained out at room temperature. The frog and all voids in the bed face is filled with cement mortar. It is stored under the damp jute bags for 24 h followed by immersion in clean water for 3 days. The specimen is placed with flat faces horizontal, and mortar filled face facing upwards between two 3 ply plywood sheets each of 3 mm thickness and carefully centered between plates of testing machine. Load is applied axially at a uniform rate of 14 N/mm<sup>2</sup> per minute till failure occurs. The maximum load at failure is noted down. The load at failure is considered the maximum load at which the specimen fails to produce any further increase in the indicator reading on the testing machine.

##### 5.2 Water Absorption Test

5 bricks are taken and the bricks are weighed dry and the average dry weight of 5 bricks is calculated. Bricks are then immersed in water for a period of 24 hours. After 24 hours of immersion, bricks are weighed again and average of 5 bricks is calculated. The difference of the final average weight and initial average weight indicates the amount of water absorbed by the bricks. It should not in any case exceed 20 percent of average weight of dry bricks.

A brick is taken and it is weighed in dry condition.



Fig:3-WATER ABSORPTION TEST ON ADMIXTURE ADDED BRICK

5.3 Efflorescence test

Efflorescence is a crystalline, salty deposit that occurs on the surfaces of bricks. A good quality brick should not contain any soluble salts in it. If soluble salts are there, then it will cause efflorescence on brick surfaces. To know the presence of soluble salts in a brick, placed it in a water bath for 24 hours and dry it in shade. After drying, observe the brick surface thoroughly. If there is any white or grey color deposits, then it contains soluble salts and not useful for construction.



Fig:4- EFFLORSCENCE TEST ON ADMITURE ADDED BRICK

5.4 Soundness test

In this test, the two bricks are taken and they are struck with each other. The bricks should not break and a clear ringing sound should be produced.

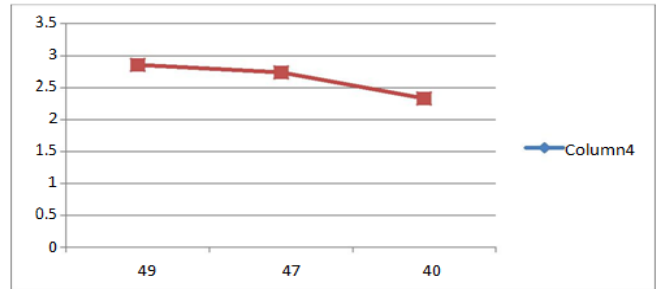
VI. RESULTS

The compressive strength of the different proportions are arrived and the results are compared with normal brick. The compressive strength of various proportions are listed in tables below.

TABLE:1- COMPRESSIVE STRENGTH OF NORMAL BRICK

S.No	Load(kN)	Compressive strength(N/mm <sup>2</sup> )
1	49	2.86
2	47	2.74
3	40	2.33

GRARH:1-COMPRESSIVE STRENGTH OF NORMAL BRICK

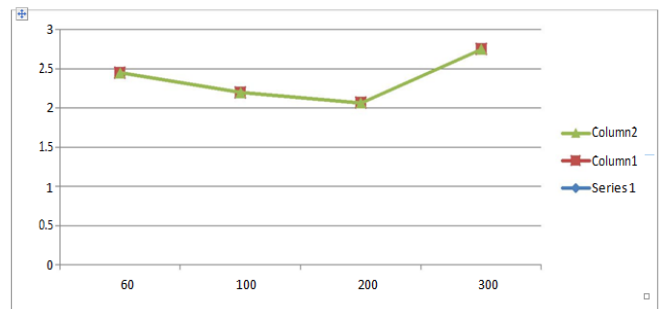


The X-axis denote the load applied on the brick & Y-axis denote the compressive strength of the normal brick.

TABLE: 2- COMPRESSIVE STRENGTH OF 25Gms OF JAGGERY, ORDINARY WATER WITH CLAY SOIL

S.NO	Ratio of proposition(ml)	Compressive strength(N/mm <sup>2</sup> )
1	60	2.45
2	100	2.2
3	200	2.01
4	300	2.75

GRAPH: 2- COMPRESSIVE STRENGTH OF 25Gms OF JAGGERY, ORDINARY WATER WITH CLAY SOIL

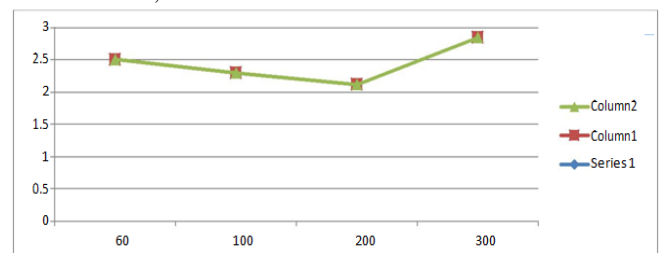


The X-axis denote the Ratio of mix proportion added to brick & Y-axis denote the Compressive strength of the brick.

TABLE 3: COMPRESSIVE STRENGTH OF 50Gms of JAGGERY, ORDINARY WATER WITH CLAY SOIL

S.NO	Ratio of proposition(ml)	Compressive strength(N/mm <sup>2</sup> )
1	60	2.51
2	100	2.3
3	200	2.12
4	300	2.85

GRAPH:3-COMPRESSIVE STRENGTH OF 50Gms of JAGGERY, ORDINARY WATER WITH CLAY SOIL

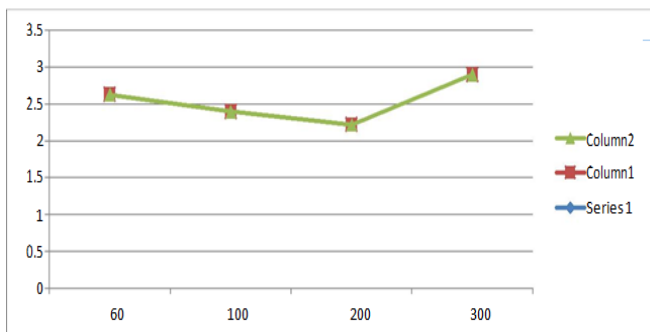


The X-axis denote the Ratio of mix proportion added to brick & Y-axis denote the Compressive strength of the brick

TABLE:4- COMPRESSIVE STRENGTH OF 100Gms OF JAGGERY ,ORDINARY WATER WITH CLAY SOIL

S.NO	Ratio of proposition(ml)	Compressive strength(N/mm <sup>2</sup> )
1	60	2.63
2	100	2.4
3	200	2.22
4	300	2.9

GRAPH:4-COMPRESSIVE STRENGTH OF 100Gms OF JAGGERY ,ORDINARY WATER WITH CLAY SOIL

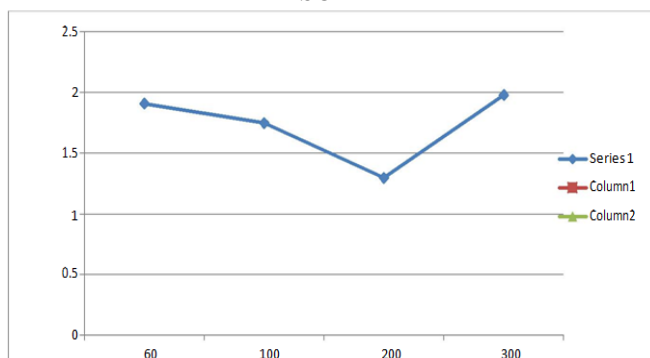


The X-axis denote the Ratio of mix proportion added to brick & Y-axis denote the Compressive strength of the brick.

TABLE:5- COMPRESSIVE STRENGTH OF 25Gms OF PALM JAGGERY ,ORDINARY WATER WITH CLAY SOIL

S.NO	Ratio of proposition (ml)	Compressive strength (N/mm <sup>2</sup> )
1	60	1.91
2	100	1.75
3	200	1.3
4	300	1.98

Graph:5- COMPRESSIVE STRENGTH OF 25Gms OF PALM JAGGERY,ORDINARY WATER WITH CLAY SOIL

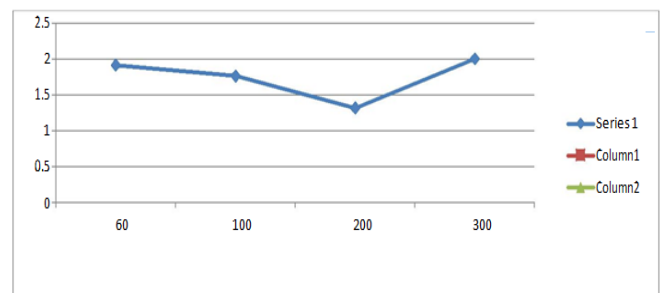


The X-axis denote the Ratio of mix proportion added to brick & Y-axis denote the Compressive strength of the brick

TABLE6: COMPRESSIVE STRENGTH OF 50Gms OF PALM JAGGERY, ORDINARY WATER WITH CLAY SOIL

S.NO	Ratio of proposition (ml)	Compressive strength (N/mm <sup>2</sup> )
1	60	1.92
2	100	1.77
3	200	1.32
4	300	2.01

GRAPH:6- COMPRESSIVE STRENGTH OF 50Gms OF PALM JAGGERY, ORDINARY WATER WITH CLAY SOIL

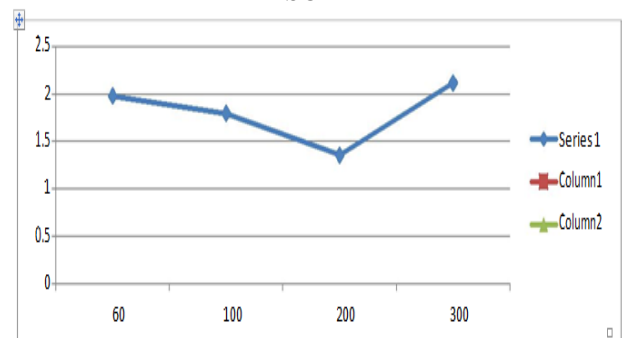


The X-axis denote the Ratio of mix proportion added to brick & Y-axis denote the Compressive strength of the brick

Table 7: COMPRESSIVE STRENGTH OF 100Gms OF PALM JAGGERY, ORDINARY WATER WITH CLAY SOIL

S.NO	Ratio of proposition (ml)	Compressive strength (N/mm <sup>2</sup> )
1	60	1.98
2	100	1.8
3	200	1.36
4	300	2.12

GRAPH:7- COMPRESSIVE STRNGTH OF 100Gms OF PALM JAGGERY, ORDINARY WATER WITH CLAY SOIL

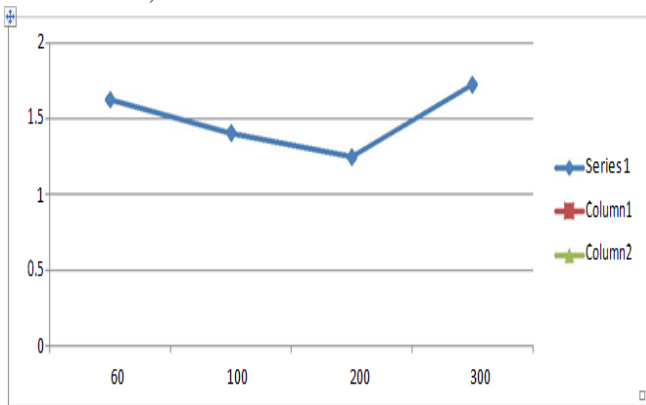


The X-axis denote the Ratio of mix proportion added to brick & Y-axis denote the Compressive strength of the brick

TABLE 8: COMPRESSIVE STRENGTH OF 25Gms OF JAGGERY, KADUKAAI WATER WITH CLAY SOIL

S.NO	Ratio of proposition (ml)	Compressive strength (N/mm <sup>2</sup> )
1	60	1.63
2	100	1.41
3	200	1.25
4	300	1.73

GRAPH 8: COMPRESSIVE STRENGTH OF 25Gms OF JAGGERY, KADUKKAI WATER WITH CLAY SOIL

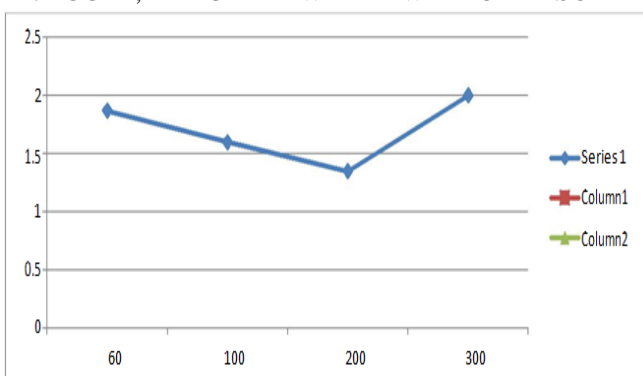


The X-axis denote the Ratio of mix proportion added to brick & Y-axis denote the Compressive strength of the brick

TABLE 9: COMPRESSIVE STRENGTH OF 50Gms OF JAGGERY, KADUKAAI WATER WITH CLAY SOIL

S.NO	Ratio of proposition (ml)	Compressive strength (N/mm <sup>2</sup> )
1	60	1.87
2	100	1.60
3	200	1.35
4	300	2.0

GRAPH 9: COMPRESSIVE STRENGTH OF 50Gms OF JAGGERY, KADUKKAI WATER WITH CLAY SOIL

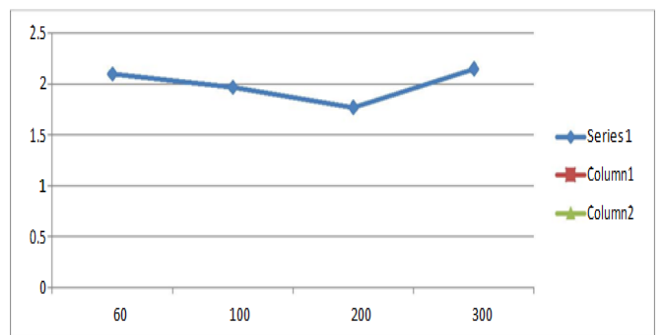


The X-axis denote the Ratio of mix proportion added to brick & Y-axis denote the Compressive strength of the brick

TABLE 8: COMPRESSIVE STRENGTH OF 100Gms OF JAGGERY, KADUKKAI WATER WITH CLAY SOIL

S.NO	Ratio of proposition (ml)	Compressive strength (N/mm <sup>2</sup> )
1	60	2.10
2	100	1.97
3	200	1.77
4	300	2.15

GRAPH 10: COMPRESSIVE STRENGTH OF 100Gms OF JAGGERY, KADUKKAI WATER WITH CLAY SOIL

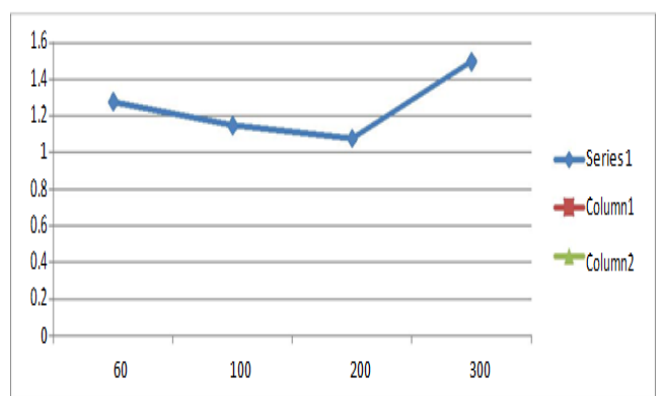


The X-axis denote the Ratio of mix proportion added to brick & Y-axis denote the Compressive strength of the brick

TABLE 11: COMPRESSIVE STRENGTH OF 25Gms OF PALM JAGGERY, KADUKKAI WATER WITH CLAY SOIL

S.NO	Ratio of proposition (ml)	Compressive strength (N/mm <sup>2</sup> )
1	60	1.28
2	100	1.15
3	200	1.08
4	300	1.5

GRAPH 11: COMPRESSIVE STRENGTH OF 25Gms OF PALM JAGGERY, KADUKKAI WATER WITH CLAY SOIL

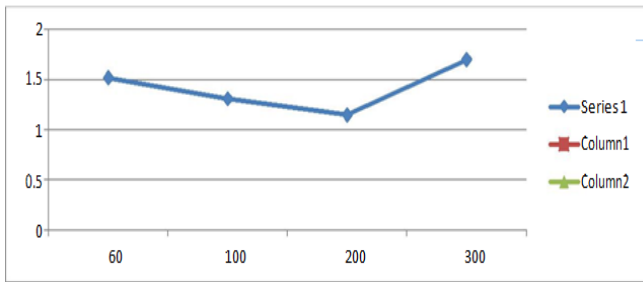


The X-axis denote the Ratio of mix proportion added to brick & Y-axis denote the Compressive strength of the brick

TABLE 12: COMPRESSIVE STRENGTH OF 50Gms OF JAGGERY, KADUKKAI WATER WITH CLAY SOIL

S.NO	Ratio of proposition (ml)	Compressive strength (N/mm <sup>2</sup> )
1	60	1.52
2	100	1.31
3	200	1.15
4	300	1.7

GRAPH:12- COMPRESSIVE STRENGTH OF 50Gms OF JAGGERY, KADUKKAI WATER WITH CLAY SOIL

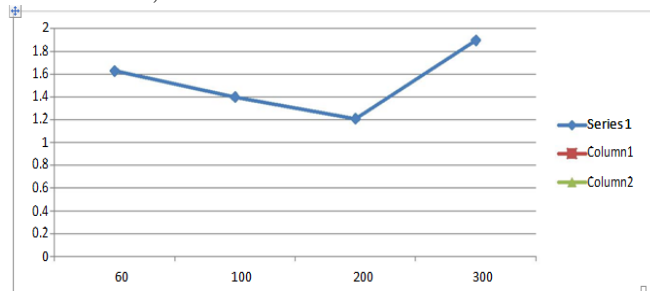


The X-axis denote the Ratio of mix proportion added to brick & Y-axis denote the Compressive strength of the brick

TABLE 13: COMPRESSIVE STRENGTH OF 100Gms OF JAGGERY, KADUKKAI WATER WITH CLAY SOIL

S.NO	Ratio of proposition (ml)	Compressive strength (N/mm <sup>2</sup> )
1	60	1.63
2	100	1.40
3	200	1.21
4	300	1.9

TABLE 13: COMPRESSIVE STRENGTH OF 100Gms OF JAGGERY, KADUKKAI WATER WITH CLAY SOIL

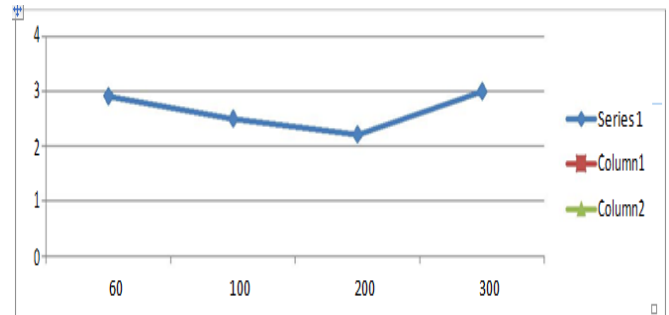


The X-axis denote the Ratio of mix proportion added to brick & Y-axis denote the Compressive strength of the brick

TABLE 14: COMPRESSIVE STRENGTH OR 25Gms OF JAGGERY, PALM JAGGERY, KADUKKAI WATER WITH CLAY SOIL

S.NO	Ratio of proposition (ml)	Compressive strength (N/mm <sup>2</sup> )
1	60	2.92
2	100	2.51
3	200	2.22
4	300	3

GRAPH:14- COMPRESSIVE STRENGTH OR 25Gms OF JAGGERY, PALM JAGGERY, KADUKKAI WATER WITH CLAY SOIL

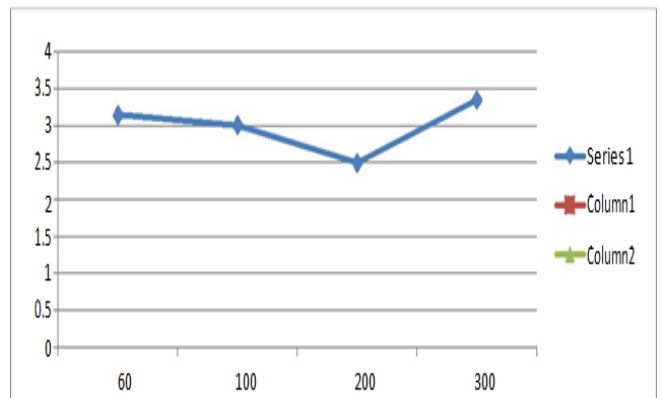


The X-axis denote the Ratio of mix proportion added to brick & Y-axis denote the Compressive strength of the brick

TABLE 15: COMPRESSIVE STRENGTH OR 50Gms OF JAGGERY, PALM JAGGERY, KADUKKAI WATER WITH CLAY

S.NO	Ratio of proposition (ml)	Compressive strength (N/mm <sup>2</sup> )
1	60	3.04
2	100	2.87
3	200	2.49
4	300	3.2

GRAPH: 15- COMPRESSIVE STRENGTH OR 50Gms OF JAGGERY, PALM JAGGERY, KADUKKAI WATER WITH CLAY SOIL

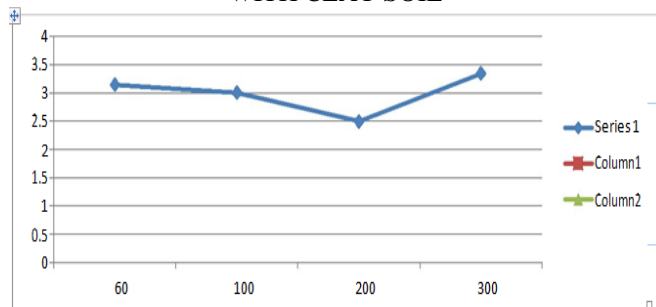


The X-axis denote the Ratio of mix proportion added to brick & Y-axis denote the Compressive strength of the brick

TABLE 16: COMPRESSIVE STRENGTH OR 100Gms OF JAGGERY, PALM JAGGERY, KADUKKAI WATER WITH CLAY SOIL

S.NO	Ratio of proposition (ml)	Compressive strength (N/mm <sup>2</sup> )
1	60	3.15
2	100	3.01
3	200	2.5
4	300	3.35

GRAPH:-16 COMPRESIVE STRENGTH OR 100Gms OF  
JAGGERY, PALM JAGGERY, KADUKKAI WATER  
WITH CLAY SOIL



The X-axis denote the Ratio of mix proportion added to brick & Y-axis denote the Compressive strength of the brick

Table 17: Water absorption of bricks

Type of brick	Specimen 1	Specimen 2	Specimen 3	Specimen 4	Specimen 5	Avg. water absorption
Ordinary brick	12.40%	12.39%	12.64%	12.66%	12.56%	12.53%
Admixture added brick	12.74%	12.53%	12.43%	12.39%	11.48%	12.30%

Table 18: Efflorescence test results of bricks

Type of brick	Description	Extent of deposits
Ordinary brick	Slight	10% area covered with the salts deposits
Admixture added brick	Nil	No perceptible deposit of efflorescence

## VII. CONCLUSION

Normal brick compressive strength is 2.86N/mm<sup>2</sup>. Comparatively jaggery and ordinary water combination gives 2.9N/mm<sup>2</sup> compressive strength greater than normal brick of at 300ml. Palm jaggery and ordinary water gives less compressive strength than normal brick. compare those above two ingredients (1&2) jaggery gives more strength to bricks. Jaggery and kadukkai water combination gives the less compressive strength than normal brick . Palm jaggery and kadukkai water combination gives the less compressive strength than the normal brick . Compare above two ingredients (3&4) nearly gives less strength then the normal bick.palm jaggery, jaggery, kadukkai, these three combination gives the greater compressive strength i.e;3.35N/mm<sup>2</sup> strength than the normal brick at 300ml.

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