# COMPARISION OF TRADITIONAL AND CONCRETE BRICKS

*A*

*PROJECT REPORT*

*Submitted in fulfilment of the requirements for the award of the degree*

*of*

**BACHELOR OF TECHNOLOGY**

**IN**

**CIVIL ENGINEERING**

*Under the supervision*

*of*

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**JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY**

**WAKNAGHAT SOLAN-173234**

**HIMACHAL PRADESH INDIA**

**MAY 2022**

# DECLARATION

I hereby declare that the work presented in the Project report entitled **"Comparison of Traditional and Concrete Bricks"** submitted for partial fulfilment of the requirements for the degree of Bachelor of Technology in Civil Engineering at **Jaypee University of Information Technology, Waknaghat** is an authentic record of my work carried out under the supervision of **Mr. Rohan Singhal.** This work has not been submitted elsewhere for the reward of any other degree/diploma. I am fully responsible for the contents of my project report.


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# CERTIFICATE

This is to certify that the work which is being presented in the project report titled "**COMPARISION OF TRADITIONAL AND CONCRETE BRICKS"** in partial fulfilment of the requirements for the award of the degree of Bachelor of Technology in Civil Engineering **JAYPEE UNIVERSITY OF INFORMATION AND TECHNOLOGY, WAKNAGHAT** is an authentic record of my own work carried out by SURYANSH SINGH(181629) and SAHIL NEGI(181638), under the supervision and guidance of Mr. Rohan Singhal (Assistant Professor), Department of Civil Engineering, Jaypee University of Information and Technology, Waknaghat.

The above statement made is correct to the best of our knowledge.

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# ACKNOWLEDGEMENT

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We would like to express our sincere gratitude to Mr. Rohan Singhal (Assistant Professor) who gave us the golden opportunity to do this wonderful project **"Comparison of Traditional and Concrete bricks"** and also helped us along the way and we came to know about many new things.

We would also like to extend our sincere thanks to sir. We are highly indebted to all of them for their guidance and constant encouragement and never ending support.

# ABSTRACT

The aim of our project is a comparison of traditional bricks and concrete bricks and to test and compare its cost with the most sold brick in the market that is red clay bricks. Concrete bricks can prove to be a good sustainable future as its waste can be reused in various aspects of the construction arena even to make bricks again and even giving good compressive strength values and is therefore a good solution for everlasting loads of construction with increase in population, housing and pollution problems.

We also aim to produce concrete bricks economically as the costliest ingredient in such bricks is cement and hence by making low grade concrete bricks having mix grades M5, M7.5, M10 and comparing it with the class A, class B, class C of normal red clay bricks. Although concrete has found its place in almost every sphere of construction arena and is the most common construction material.

Also used in fields like pavements, foundations, fences, construction of houses and dams too.

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# CHAPTER 1: INTRODUCTION

## 1.1 General

Bricks are a type of blocks or artificial stone used for construction purposes like building walls, pavements etc. Bricks can be joined together by the means of mortar, adhesives or by interlocking them.

Tracing back from the birth of civilisations to the era of Industrial revolution, these fundamental units forming big structures played a vital role, though the materials used in making of these bricks changed from time to time.

With advancement in time and technology, these artificial stones or bricks can be made of many different materials, classes, sizes and weights too.

### 1.1.1 Categorization based on manufacturing

**1. Extruded:** These types of bricks are forced through the opening in a steel die and have very good size and shape.
**2. Wire cut:** In this a tensioned wire is used to cut the size after extrusion and leaving drag marks.
**3. Moulded:** In this method type moulds are used for eg. steel moulds rather than being extruded.
**4. Machine-mould**: Similar to the previous method but in this machine applies pressure to fit it into moulds.

**5. Handmade**: A person physically forces clay into moulds.
**6. Dry pressed:** In this thicker clay mix is compressed with a great force usually machines are used in this method.

### 1.1.2 Categorization of bricks on the basis of use

1) **Common or building purpose:** Bricks used for construction purposes, in this the bricks are not intended to be visible by the eyes and bricks are used for the purpose of walls.

2) **Face use:** In this bricks are used on the exterior surface to present a good and clean appearance.

3) **Hollow bricks:** These bricks are not solid bricks and have holes less than 25% of the brick volume.

4) **Perforated bricks:** These bricks too have holes and holes are more than 25% of the brick volume.

5) **Paving:** These are the bricks or blocks used for the purpose of ground construction where bricks or blocks are used for ground contact as a walkway or roadway.

6) **Thin use:** In this bricks with normal height and length are used but also thin width is used as a facade.

## 1.2 Types of bricks available in the market

**1. Burnt clay bricks:** This brick type is the most common and most bountiful bricks that is available in the modern day construction, and also is used in a variety of purposes ranging from being used in columns, beams, and foundations etc. These bricks require plastering with mortar to improve brick strength, water resistance and insulation ability. This brick is used for a variety of purposes in modern day construction.

**Fig 1. Red clay bricks**

**2. Sun-dried clay bricks:** These bricks have been made since ancient times. The composition of this type of brick is clayey soil, water and straw and sometimes also includes sand to help brick from cracking and put into moulds and then left for drying. They aren't as tough as other types of bricks but they are quite budget friendly and can be used for temporary structures.

**Fig 2. Sun-dried clay bricks**

**3. Concrete bricks:** These types of bricks are made by the use of solid concrete. The concrete is put into custom moulds allowing to create different shapes and sizes. Bricks of different mix grades are made keeping in mind the requirements.

**Fig 3. Concrete brick**

**4. Engineering bricks:** These bricks have high compressive strength and density and are ideal for load bearing material, also have low absorption capacity resulting in low moisture content absorption and hence preventing it from cracking. And are for ideal use in basements.

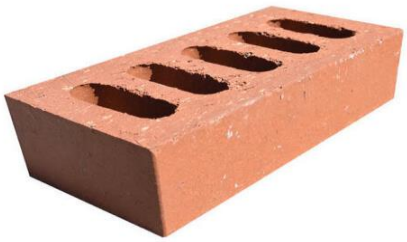


**Fig 4. Engineering bricks**

**5. Sand Lime bricks:** These bricks are a mixture of lime and sand and have high compressive strength hence an option for load bearing walls. This type of brick also uses less mortar plaster hence saving a lot of time.

**Fig 5. Sand lime bricks**

**6. Fly ash bricks:** These bricks are made by fly ash from power plants, quicklime, cement, aluminium powder, gypsum and water. These bricks have high compressive strength and low water absorption rate. Also with increase in size, it becomes less durable forming cracks.

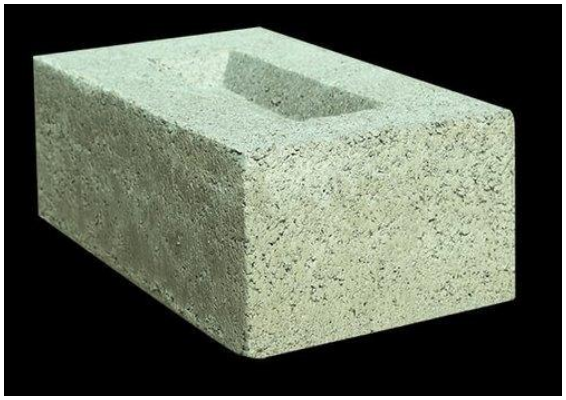


**Fig 6. Fly ash brick**

**7. Fire bricks:** These bricks were created with a main motive of creating bricks having high resistance to heat and fire. These bricks are made of clay also called fire clay containing high levels of alumina and silica and can withstand temperatures up to 3000**°C.**

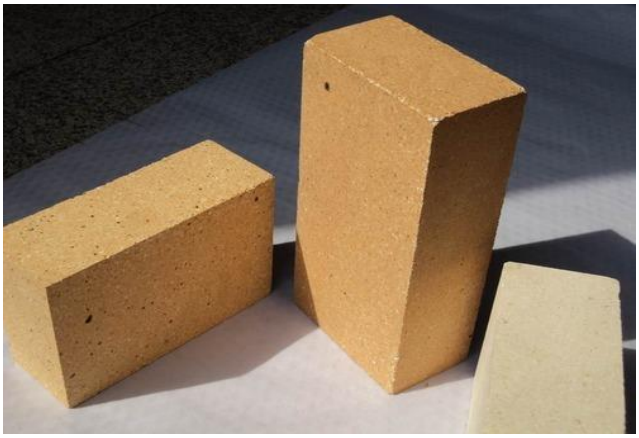


**Fig 7. Fire bricks**

## 1.3 Problems with regular red bricks and its manufacturing

**1. Efflorescence:** When bricks come in contact with water or moisture, water is absorbed by them, the absorbed water dries out through the process of evaporation and so does the soluble salts in the bricks resulting in formation of white powder type substance on the surface of bricks.


***Fig 8. Efflorescence***

**2. Over-burning of bricks:** In this scenario, soft molten mass is produced and brick loses its shape and can't be used for any construction purpose.

**3. Under-burning of bricks:** In this case, bricks are not burnt to complete verification and due to insufficient heat and pores are not closed causing higher water content absorption and less compressive strength.

**4. Bloating:** In this defect a spongy swollen mass can be observed over the surface of burned bricks can is due to excess carbon and its compounds plus sulphur present in there.

**5. Black core:** When brick clay having bituminous matter is not properly removed by oxidation, brick forms black core due to improper burning.

**6. Chuffs:** It is caused by rain water falling on hot bricks which causes shape deformation.

**7. Environmental concern:** Red clay bricks are basically sustainable and natural but as the clay used is taken from the top layer of soil, and with a boom in population and housing construction it poses threat to the top layer of soil.

**8.** When unloading from cargo carriers, these bricks often lose their corners and sometimes even crack.

## 1.4 Concrete bricks as a solution

**1.4.1 Concrete as a construction material:** It is a composite material, man-made and is a widely used material in construction. It consists of cement (or lime), fine aggregates and coarse aggregates and water.

In today’s scenario most of the construction work is dominated by cement and concrete because of its versatility.

Rational proportions of cement, fine aggregate and coarse aggregates give different mix grades of concrete according to its use and requirement.

### 1.4.2 Benefits of concrete bricks

**1. Good way to create effective low maintenance home in a heavy rain/ moisture prone area:** Concrete bricks don't attract mildew and show resistance towards pests that can impact a structure in such an area with good moisture content and thus reduces the structural damage.

**2. Shows great resistance towards strong winds:** These are very useful for buildings in areas having strong winds for example cities near sea shores often face strong coastal winds in peak season time, it also creates a natural resistance to wind speeds that blow through during hurricanes and storms and with proper maintenance of the structure it can last for years to come.

**3. Fire resistance:** Simply as cement isn’t flammable and hence can provide resistance against fire for a good amount of time in case of any mishap.

4. It can lower the home energy requirements by acting as an insulation between outside and inside, the cold air or hot air from inside wouldn’t easily escape the four walls and so does the outside weather. Resulting is lesser requirements of energy for the same use.

**5. Also creates sound insulation:** The design of concrete brick homes naturally creates soundproofing. Nearly 65% - 75% of the outside noise directly gets blocked when using this material.

**6.** It acts as a moisture barrier preventing several damp spots that could allow spores and allergens from entering the house.

**7.** In case of any undesired calamity the concrete brick house is easier to re-build in comparison to others, as waste concrete can also be used as construction material.

**8. Affordable and sustainable:** The raw materials used here are sustainable and recyclable. The production produces less CO2 levels and in the process it uses less energy in comparison to the other building materials.

**9. Durability and strength:** Concrete bricks can easily stand past the test of time. Even the World's Business Council for Sustainable Development's Cement sustainability initiative said that concrete gets stronger with time and it is unaffected by moisture, pests etc. Hence possesses good load bearing capacity.

## 1.5 Difference between Concrete bricks and regular red bricks

| SI. No. | Parameter | Red bricks | Concrete bricks |
|---|---|---|---|
| 1. | Raw Materials | Lime Clay or Alumina, Sand, Iron Oxide, Magnesia. | Cement, sand, water, aggregates. |
| 2. | Properties | Size -190*90*90 (mm) | Size-200*100*40 (mm) |
| 3. | Environmental Impact | Clay used is available naturally. But also depletes the top fertile soil and emits a lot of carbon during manufacturing. | The amount of carbon dioxide emitted in its making is less. |

| | | | |
|---|---|---|---|
| 4. | Consumption of mortar | Regular red bricks have irregularities in its surface and hence the mortar consumed by it is high. | Solid concrete bricks have flat and similar even type surfaces and hence the mortar demand is less compared to red bricks. |
| 5. | Usage of water | Takes a lot of time to cure. | Solid concrete bricks require a high amount of water and requires a curing for at least 7-14 days. Demanding a high amount of water with respect to red bricks. |
| 7. | Cost | Though red bricks cost less but with high demand of mortar overall cost of construction increases. | Its cost is high compared piece to piece but it also requires less mortar and has a high load bearing capacity. |
| 8. | Uses | Used as structural material in buildings, foundations, pavement and other artful purposes like landscaping. | These can be employed as both load bearing and non-load bearing in walls. It can also be used as backing for piers, retaining walls, chimneys and fireplaces etc. |

# CHAPTER 2: LITERATURE REVIEW

## 2.1 Introduction

Use of concrete as a building material in the form of bricks providing good compressive strength i.e. good for load bearing.

In this project our aim is to cast concrete mix designs of M5, M7.5, M10 and compete them against the class A, class B, class C type bricks.

Testing bricks and making a cost analysis between them.

Both bricks have their own set of pros and cons, but with advancement in time and technology concrete bricks offer more, let it be in terms of sustainability and low carbon emission in production, moisture profile or high compressive strength values.

There are many issues with regular red bricks like efflorescence, over-burning, under-burning, bloating, black core, chuffs that the solid concrete bricks don't face plus they also are a good solution in high moisture area, area with strong

winds, fire resistant, sound insulation etc. As it acts as a moisture barrier it prevents several damp spots that could allow spores and allergens from entering the house.

We will discuss more about solid concrete bricks in this project along with cost analysis.

## 2.2 Research Papers & Indian codes used in this study

Following are the Indian standard codes and research papers we studied over a period of time regarding our project work:

**1.** Konstantin Kovler, et.at. [1] shows literature regarding fresh and hardened concrete. They addressed the properties of fresh concrete like slump loss, setting time, segregation and practical

issues related to structure filling and pressure, workability and basic rheological properties and setting time etc. And addressed the properties of hardened concrete like compressive strength, mechanical and physical properties like tensile strength, flexure properties, shrinkage, cracking resistance etc. are covered. Testing interpretation modelling and prediction of data too are conveyed in this paper along with effects of added reinforcements, natural and recycled aggregates, added admixtures too are discussed here, with the major focus on hardened lightweight and self-compacting concrete.

**2.** IS 10262: 1982 (Reaffirmed 2009), Recommended guidelines for concrete mix design, Bureau of Indian Standards, New Delhi.

**3.** IS 4031: 1988 (Part XI), Methods of tests for compressive strength of cement, Bureau of Indian Standards, New Delhi.

**4.** IS 4031:1988 (Part VI), Methods of test of compressive strength of cement, Bureau of Indian Standards, New Delhi.

**5.** IS 4031:1988 (Part V), Methods of tests for determination of initial and final setting time of cement, Bureau of Indian Standards, New Delhi.

**6.** IS 4031:1988 (Part IV), Methods for test and standard consistency of cement, Bureau of Indian Standards, New Delhi.

**7.** IS 2386:1963 (Part III), Methods for test of sieve analysis of coarse aggregates and fine aggregates, Bureau of Indian Standards, New Delhi.

**8.** IS 2386: 1963 (Part I), Methods for test of specific gravity of aggregates, Bureau of Indian Standards, New Delhi.

**9.** IS 383: 1970 (Reaffirmed 2011), Specifications for coarse and fine aggregates from natural sources for concrete, Bureau of Indian Standards, New Delhi.

**10.** IS 456: 2000, Code of practice Plain and Reinforced Concrete, Bureau of Indian Standards, New Delhi.

**11.** IS 516: 1959 (Reaffirmed 1999), Methods of test for strength of concrete, Bureau of Indian Standards, New Delhi.

**12.** IS 3466-1988 (Specifications for masonry cement), it addresses and provides the requirements for masonry cement that is used for general purpose in which mortars are needed for masonry.

**13.** IS: 3590-1966, Load bearing lightweight concrete blocks, providing specifications for load bearing light weight concrete blocks with the manufacture of lightweight concrete aggregates from industrial waste.

**14.** S. B Ankesh,et.al [2], addressed the issue that after the lifespan of a structure is over, the demolished waste rather than going to landfills needs to find its place again in the construction arena calling for sustainable development. The motivation in this thesis was to determine the strength characteristics of concrete using recycled aggregates from waste.

In this the present experiment, an attempt was made to study the strength performance of concrete using Recycled Coarse Aggregates in replacement levels of 10%, 20%, 30%, 40% & 50% to Natural Coarse Aggregates and Recycled Fine aggregates in replacement levels of 3%, 6%, 9%, 12% & 15% to Natural Fine Aggregates (river sand) and compared the following results to that of standard concrete.

**15.** Dr. K Ramadevi,et.al [3], This thesis also worked on the goals of effective utilisation of concrete waste and also added value to the goal of sustainable development. In this experiment concrete waste was collected, crushed, sieved and washed and used for concreting, as a replacement for natural coarse aggregates in the quota of 0%, 30%, 60%, 100%. The results showed that it boosted the compressive strength of the specimen, but tensile and flexural strength was almost equal to that of the standard brick.

## 2.3 Research Gap

From various research papers we came to a conclusion that various aggregates constituted differently in the behaviour of concrete in the form of compressive strength, split tensile strength and flexural strength.

Adding different types of aggregates also mainly contributed to the compressive strength of the brick and contributed almost nothing to the tensile and flexural strength of the concrete.

Only addition of iron bars inside of concrete can contribute to the tensile and flexural strength, also adding prestressed iron bars contribute even more to the tensile strength values compared to that of the standard specimen.

## 2.4 Testing of concrete bricks

For testing, the specimens of solid concrete bricks that were immersed in the curing tank are taken out, which were immersed in for 7 days, 14 days, 28 days to perform various tests like compressive strength test, split tensile strength test etc.

The solid concrete brick specimens were tested on the universal compression testing machine. Three specimens of different mix grades M5, M7.5, M10 would be tested at 7 days, 14 days, 28days and the average value would be calculated.

**1. Slump test:** This test is conducted in order to measure the workability or consistency of the concrete, and it is one of the most commonly used tests.

Also on very wet concrete or very dry concrete this test is not suitable. This test is conducted from batch to batch to check on the uniformity of the concrete.

It is the simplest test to check on the workability or consistency of concrete as it is a low cost test and provides immediate results. It also indicates the cement- water ratio, but factors like material properties, mixing methods also affect the concrete slump value.

**2. Compressive strength test:** This test provides a good idea about the characteristics of concrete. This test helps in judging whether concreting has been done properly or not.

Compressive strength tests of concrete bricks depend on various factors like cement-water ratio, strength of cement, quality of concrete material etc.

Compressive strength formula for any given material is the load applied at the point of failure divided by the cross sectional area on which the load is applied.

Compressive strength = Load / Cross-sectional area.

For a compressive strength test a minimum of 3 specimens are needed. And the specimens are tested on the compression testing machine.

**3. Split tensile/ Tensile strength test:** Tensile strength is one of the important properties of concrete. Tensile strength is important as structural loads make concrete unguarded to tensile cracking.

Generally tensile strength of concrete is much lower than the compressive strength values of concrete, roughly saying tensile strength value is about 10% of the compressive strength of concrete. Indirect methods are applied for the testing of concrete bricks due to the difficulty of direct methods.

These indirect methods are:

1- Split cylinder test

2- Flexural test

For the tensile strength test a minimum of three specimens are needed and tensile strength should be the average of three tested specimens.

## 2.5 Research Objectives

The research objective of our project is to design concrete bricks and to test and compare its cost with the most sold brick in the market that is red clay bricks.

Concrete bricks can prove to be a good sustainable future as its waste can be reused in various aspects of the construction arena even to make bricks again and even giving good compressive strength values and is therefore a good solution for everlasting loads of construction with increase in population, housing and pollution problems.

Basically we are aiming to produce concrete bricks economically as the costliest ingredient in such bricks is cement and hence by making low grade concrete bricks having mix grades M5, M7.5, M10 and comparing it with the class A, class B, class C of normal red clay bricks.

Although concrete has found its place in almost every sphere of the construction arena and is the most common construction material also used in fields like pavements, foundations, fences, construction of houses and dams too.

# CHAPTER 3: EXPERIMENTAL STATUS

## 3.1 Design of Concrete mixes

The fundamental objective is proportioning mortar mix to produce a durable material of necessary strength. Impermeable to water, good compressive strength etc. also at minimum price. Also the mix must be workable so for this reason the combination design becomes executed to rationalise various frameworks in the application of concrete. And also cement is the costliest ingredient in this mix, so the ratio in which cement is being used must be small and consistent to attain desired results. For the purpose of acquiring concrete with desirable attributes, the ratios of cement, fine aggregates and coarse aggregates give us a mixed design of different strength values.

### 3.1.1 Mix design by Indian Standard Recommended Guidelines

The guidelines are given in various codes like IS: 10262-2009, IS:383-1970 and IS: 456-2000 for the mix design of concrete.

In this experiment we are using the following mix designs:

1. M5

2. M7.5

3. M10

## 3.2 Characteristics of materials

### 3.2.1 Physical properties of Coarse Aggregate

| Characteristics | Value |
|---|---|
| Colour | Grey like |
| Type | Crushed |
| Shape | Angular |
| Specific gravity | 2.65 |
| Water absorption | 1% |
| Fineness modulus | 6.5 |
| Moisture Content (%) | - |

### 3.2.2 Physical properties of fine aggregates

| Characteristics | Results Obtained |
|---|---|
| Grading | Grading zone II (IS: 383- 2011) |
| Fineness Modulus | 2.2 |
| Specific gravity | 2.7 |
| Water absorption (%) | 0.55% |
| Free moisture content (%) | 2% |

### 3.2.3 Cement

Ordinary Portland Cement (OPC) of Ambuja cement from a single batch is used for all the concrete mixes. Cement taken formed no lumps with a uniformity in its colour.

The cement was tested for its normal consistency according to IS: 8112- 2013 for its normal consistency, initial and final setting time, specific gravity, and compressive strength for 3, 7, 28 days and the results are concluded in the following table.

### 3.2.3.1 Physical properties of cement

| Sr. No. | Properties | Experimental values | Specified value as per IS:8112- 2013 |
|---|---|---|---|
| 1 | Consistency of cement | 30% | - |
| 2 | Specific gravity | 3.10 | 3.15 |
| 3 | Initial setting time | 115 mins | >30 mins |
| 4 | Final setting time | 256 mins | <600 mins |

## 3.2.4 Attributes of materials

| | |
|---|---|
| Cement Used - | OPC |
| Specific gravity of cement- | 3.10 |
| Specific gravity of coarse aggregate- | 2.65 |
| Specific gravity of fine aggregate- | 2.7 |
| Water absorption of coarse aggregate- | 1% |
| Water absorption of fine aggregate- | 0.55% |
| Free surface moisture of coarse aggregate- | 0% |
| Free surface moisture of fine aggregate- | 2% |

### 3.2.5 Target mean strength of concrete

Target strength is defined as the defined strength determined for the manufacture of reinforced concrete.

$$f_m = f_{ck} + 1.65x$$

$f_m$ - Target mean strength, $f_{ck}$ - Characteristic compressive strength,

x - Standard deviation

x= 3.5 N/mm$^2$

Target mean strength of M5 concrete = 10.775 N/mm$^2$

Target mean strength of M7.5 concrete = 13.275 N/mm$^2$

Target mean strength of M10 concrete = 15.775 N/mm$^2$

### 3.2.6 Water Cement Ratio

- Water cement ratio for target mean strength for M5– 6:5

- Water cement ratio for target mean strength for M7.5- 9:10

- Water cement ratio for target mean strength for M10- 17:25

### 3.2.7 Cement content

**For M5**

1. Water cement ratio = 1
2. Quantity of water required = 0.25 L
3. Cement required = 0.25 kg

**For M7.5**

1. Water cement ratio = 1
2. Quantity of water required = 0.307 L
3. Cement required = 0.307kg

**For M10**

1. Water cement ratio = 1
2. Quantity of water required = 0.4 L
3. Cement required = 0.4 kg

## 3.2.8 Proportions of fine and coarse aggregates by volume

**For M5**

1. Total volume = 0.0016 $m^3$
2. Volume of fine aggregates = 0.00051 $m^3$
3. Volume of coarse aggregates = 0.001 $m^3$

**For M7.5**

1. Total volume = 0.0016 $m^3$
2. Volume of fine aggregate = 0.00048 $m^3$
3. Volume of coarse aggregate = 0.001 $m^3$

**For M10**

1. Total volume= 0.0016 $m^3$
2. Volume of fine aggregate = 0.0005 $m^3$
3. Volume of coarse aggregate = 0.001 $m^3$

## 3.2.9 Mix calculations

The mix calculations per unit volume of concrete is given below:

Volume of concrete = 1$m^3$

**For M5**

1. Volume of cement = Mass of cement / (specific gravity x 1000)

= 0.008 $m^3$

2. Volume of water = Mass of water / (specific gravity of water x 1000)

= 0.125 $m^3$

**For M7.5**

1. Volume of cement = Mass of cement / (specific gravity x 1000)

= 0.1 $m^3$

2. Volume of water = Mass of water / (specific gravity of water x 1000)

= 0.31 $m^3$

**For M10**

1. Volume of cement = Mass of cement/ (specific gravity x 1000)

= 0.12 $m^3$

2. Volume of water = Mass of water/ (specific gravity of water x 1000)

= 0.4 $m^3$

## 3.3 Different instruments/machineries used

### 1. Universal testing machine


**Fig 9. Universal Testing Machine**

**2. Concrete mixer-**

**Fig10. Concrete mixer**

**3. Vibrating machine-**

**Fig 11. Vibrating machine**

## 3.4 Methodology

Materials required for brick formation: cement, river sand/ fine aggregates, natural coarse aggregates, water.

**1. Preparation of moulds for casting -** All moulds are cleaned, screwed tight and oiled at all the surfaces to prevent adhesion.

**2.** Concrete bricks of required sizes are then constituted.

* **Batching-** Cement, fine aggregates, water and coarse aggregates are then weighed using an electronic weighing machine according to their respective volume proportions.

* **Mixing-** Then materials are mixed either manually or with the help of a concrete mixer according to the quantity of mix. Mixing is done for a standard time of 3 minutes.

* **Compaction into moulds-** After properly mixing the mortar, it is placed into properly oiled cuboidal moulds with properly tightened screws.

**3. Curing-** After 24 hours of time, casted specimens are demoulded from moulds and marked with a mix grade value. After taking the specimens out the bricks are then put into curing tanks for a period of 7, 14, 28 days.

The specimens are not allowed to dry during the process/period.

Solid concrete bricks require a high amount of water and requires a curing for at least 7-14 days. Demanding a high amount of water with respect to red bricks.

**4.Testing of the specimens-** The casted specimens are taken out of the curing tank which were immersed in water, after 7, 14, 28 day's compressive strength test, split tensile strength test etc. are carried out. Minimum three specimens are required and average value is calculated w.r.t to three sample.

## 3.5 Work process / Lab work

**- Preparation of moulds for casting:**

**Fig 12. Applying oil to the moulds**

**Fig 13. Oiled moulds**

**- Batching:**

**Fig 14. Weighing water in beaker**

**Fig 15. Weighing of cement**

**- Mixing:**

**Fig 16. Manually mixed cement and other aggregates**

**Fig 17. Mixing materials together in concrete mixer**

**Fig 18. Taking out the mortar paste**

**Fig 19. Prepared mortar**

**- Putting mortar into cuboidal moulds:**

**Fig 20. Putting mortar into the moulds**

**Fig 21. Making the exposed surface smooth**

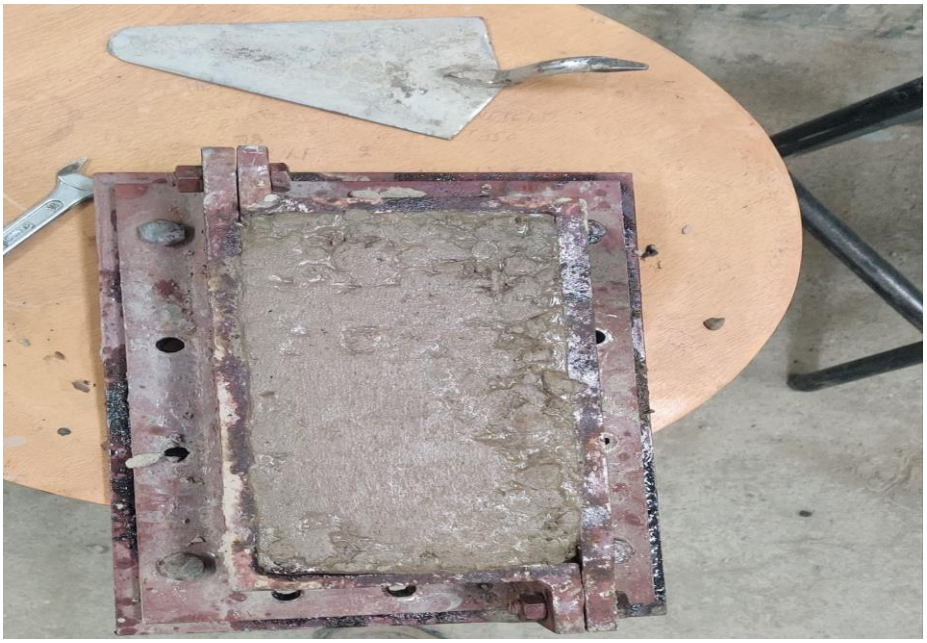


**Fig 22. Properly casted mortar in moulds**

**Fig 23. First lot of M5 specimens**

**Fig 24. Specimens of M7.5 bricks**

**Fig 25. M10 specimens**

**- Demoulding the specimens after 24 hours timespan:**

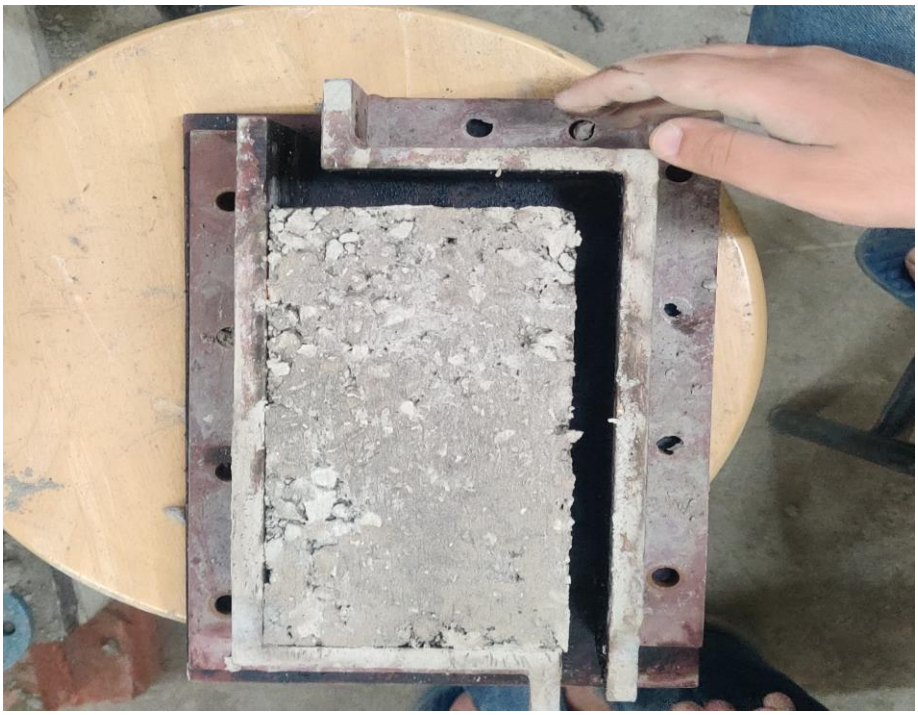


**Fig 26. Removing sides carefully**

**Fig 27. Demoulding of M7.5 mix grade concrete bricks**

**- Curing of concrete bricks:**

**Fig 28. Putting concrete bricks into the tank**

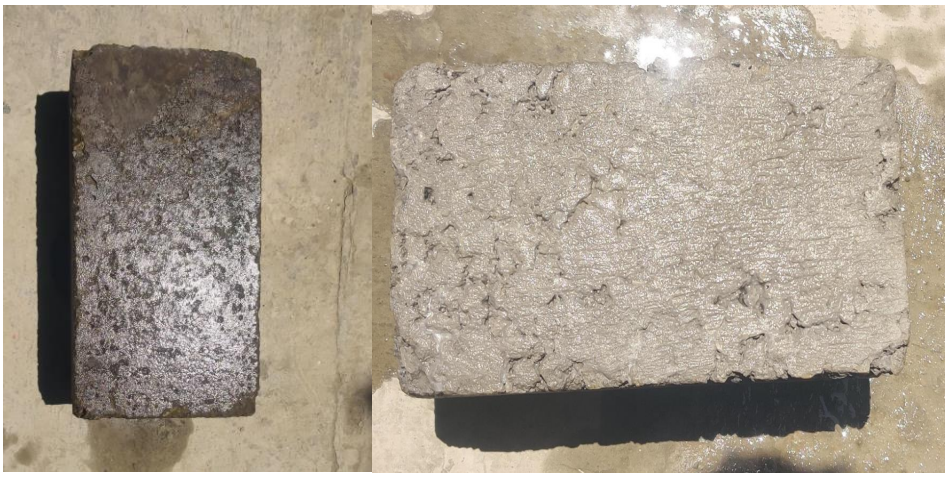


**Fig 29. Keeping bricks in open environment for 15-20 minutes before testing**

## 3.6 Testing of bricks in lab

**- Red bricks**

1. Curing red bricks in water until it properly soaks water

**Fig 30. Curing red bricks**

2. Making surface regular of red bricks for compressive strength test.

**Fig 31. Making surface smooth of red bricks**

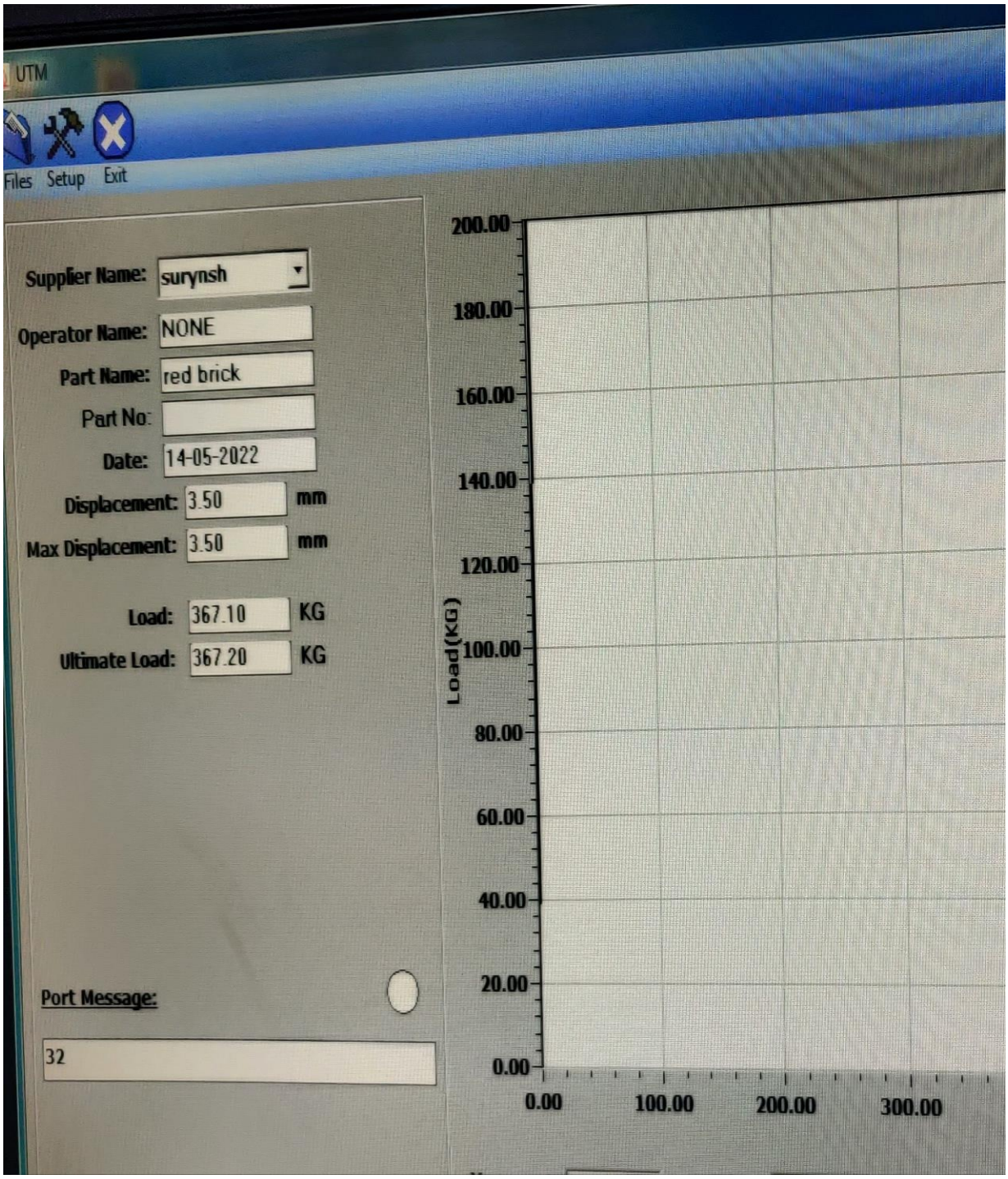
3. Keeping red bricks under 90% moisture for a day before again putting it into a curing tank for a day before its compressive strength test.

**Fig 32. Keeping red bricks in moisture for 24 hours**

4. Testing of red brick in universal testing machine

**Fig 33. Red bricks after testing**

**- Testing red brick in universal testing machine-**



**- M5 concrete bricks –**

- After 14 days

**Fig 34. M5 specimen before testing**

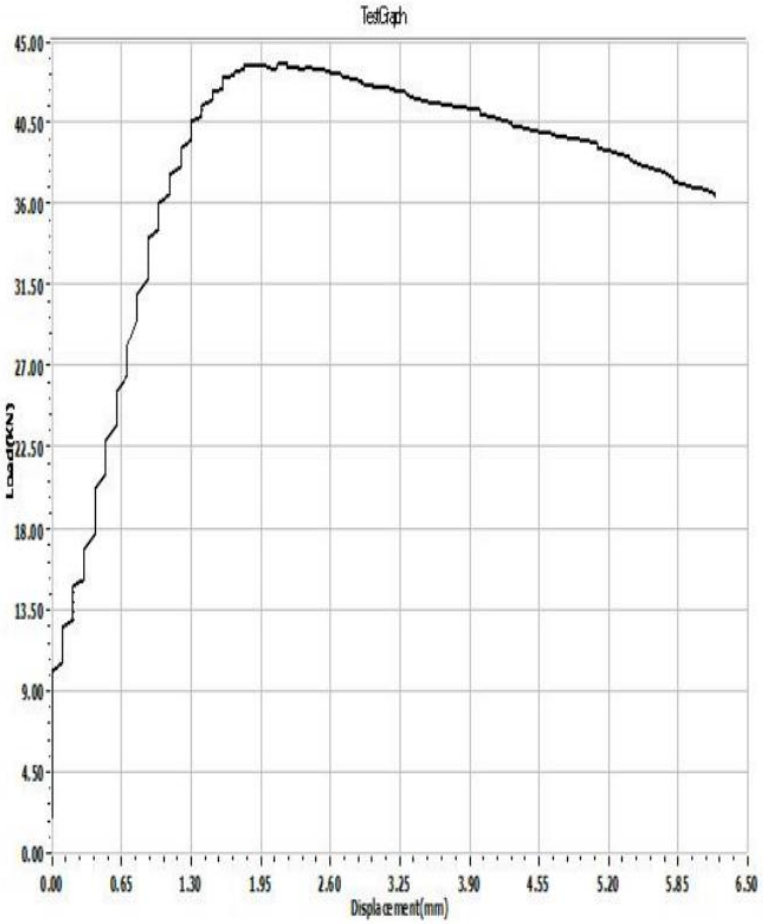
**- Compressive strength test -**

**Fig 35. Compressive strength test on M5 bricks**

# Test Report

## JAYPEE UNIVERSITY
## WAKNAGHAT

| | | | |
|---|---|---|---|
| **File** | : T13052022_1533 | | |
| **Test Type** | : COMPRESSION | | |
| **Date** | : 13-05-2022 | | |
| **Supplier Name** | : NEGI | | |
| **Operator** | : JD | | |
| **Part Name** | : BRICK M5 | **Part No** | : 14DAYS |
| **Ultimate Load(KN)** | : 43.80 | **Maximum Displacement(mm)** | : 6.20 |



**- M7.5 concrete bricks**

- After 7 days

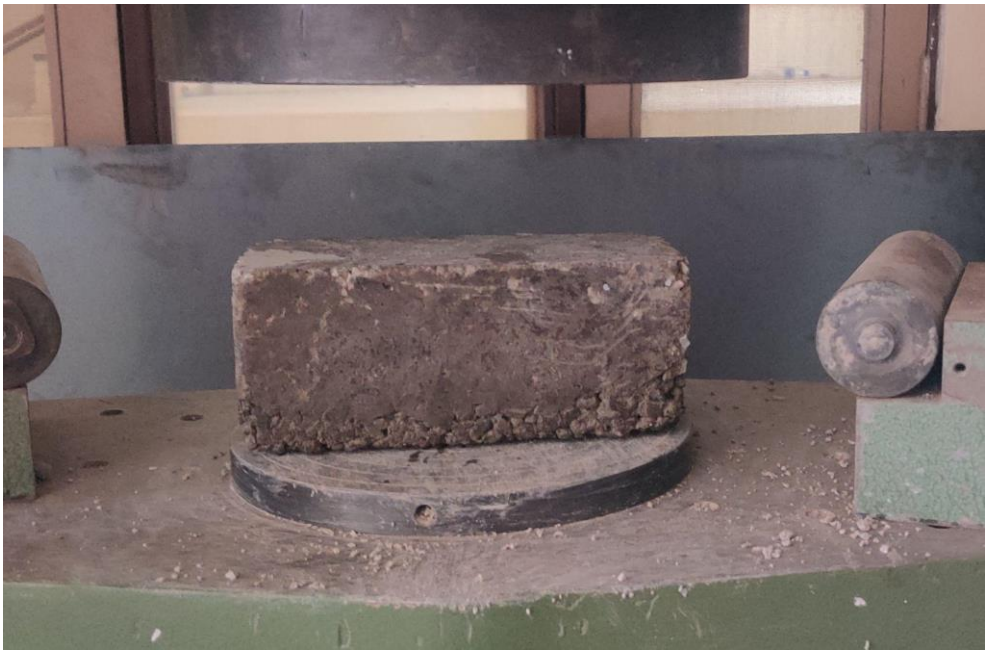


**Fig 36. M7.5 specimen before testing on 7th day**

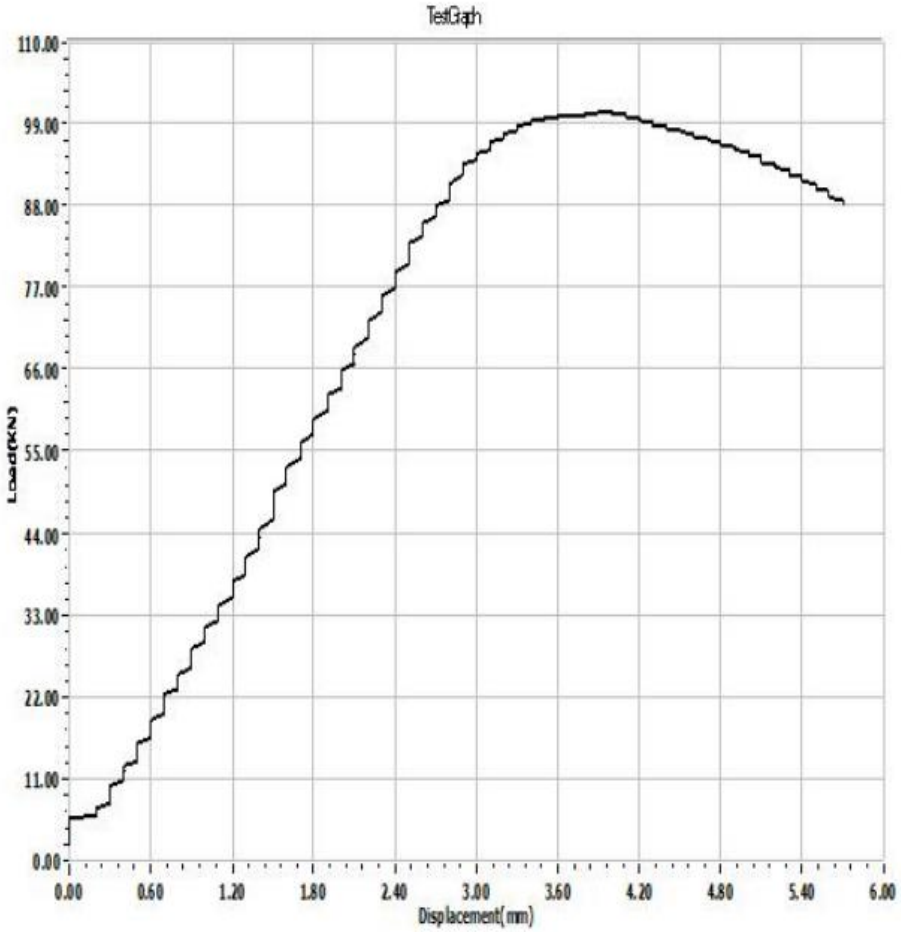
**- Compressive strength test-**

**Fig 37. Performing compressive strength test at day 7 for M7.5 bricks**

# Test Report

## JAYPEE UNIVERSITY
## WAKNAGHAT

| | | | |
|---|---|---|---|
| **File** | : T12052022_1100 | | |
| **Test Type** | : COMPRESSION | | |
| **Date** | : 12-05-2022 | | |
| **Supplier Name** | : negi | | |
| **Operator** | : JD | | |
| **Part Name** | : BRICK | **Part No** | : 100*200 |
| **Ultimate Load(KN)** | : 100.70 | **Maximum Displacement(mm)** | : 5.70 |



- After 14 days

**Fig 38. M7 specimen before testing on 14th day**

**- Compressive strength test -**

**Fig 39. Performing compressive strength test on 14th day on M7.5 specimen**

**- M10 concrete bricks**

- After 7 days

**Fig 40. M10 specimen on the 7th day before testing**

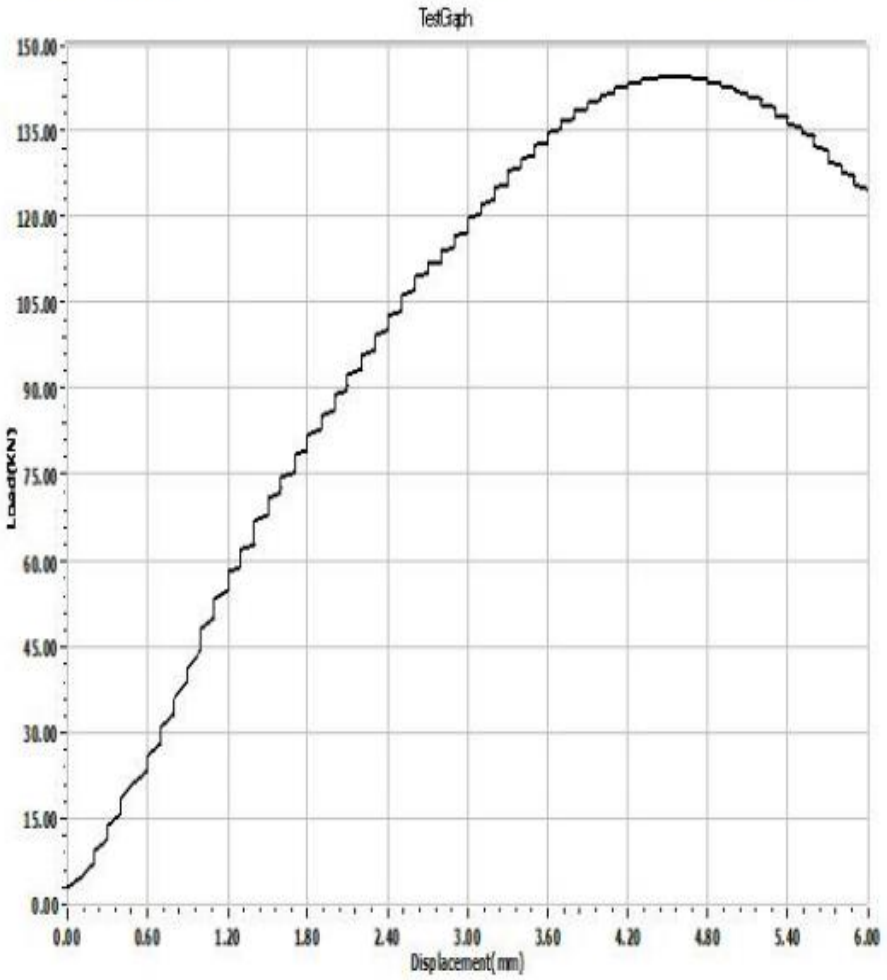
**- Compressive strength test-**

**Fig 41. M10 brick in Universal testing machine on 7th day**

# Test Report

**JAYPEE UNIVERSITY**
**WAKNAGHAT**

| | | | |
|---|---|---|---|
| **File** | : T12052022_1111 | | |
| **Test Type** | : COMPRESSION | | |
| **Date** | : 12-05-2022 | | |
| **Supplier Name** | : NEGI | | |
| **Operator** | : JD | | |
| **Part Name** | : BRICK M10 | **Part No** | : M 10 7 DAY |
| **Ultimate Load(KN)** | : 144.60 | **Maximum Displacement(mm)** | : 6.00 |

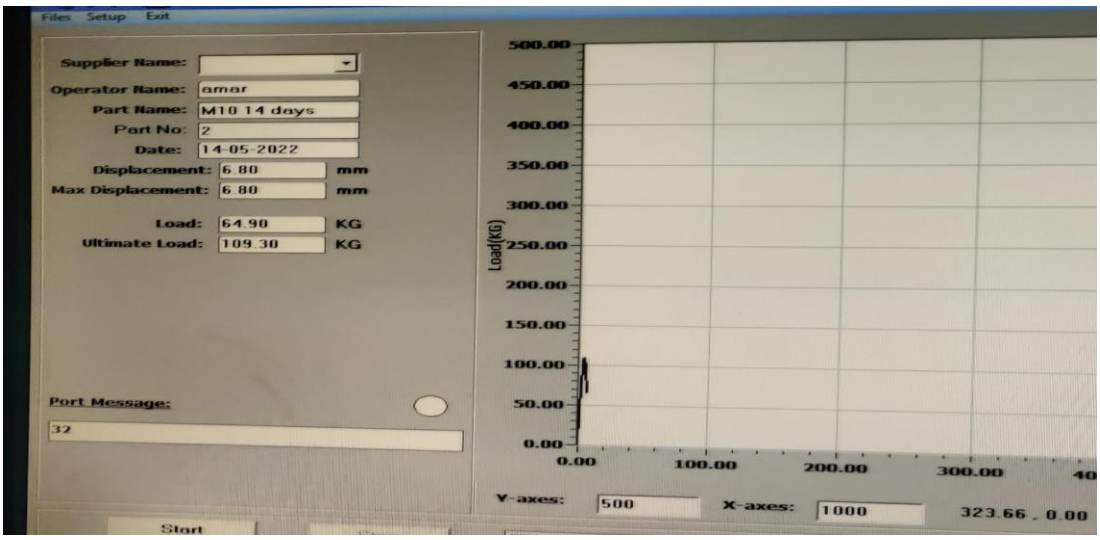


- After 14 days

**- Compressive strength test-**

**Fig 42. M10 specimen on 14th day in Universal testing machine**

**- Testing of M10 at end of 14 days -**



# CHAPTER 4: RESULTS AND DISCUSSION

## 4.1 Comparing results with red bricks-

| | |
|---|---|
| Weight of red brick - | 3kg to 3.5kg |
| Weight of concrete brick - | 4kg (approx.) |
| Compressive strength of Class A red brick - | 105 $kg/cm^2$ |
| Compressive strength of M5 concrete brick - | 5$N/mm^2$ (full strength) |
| Compressive strength of Class B red brick - | 70 $kg/cm^2$ |
| Compressive strength of M7.5 concrete brick - | 7.5$N/mm^2$ (full strength) |
| Compressive strength of Class C red brick - | 35 $kg/cm^2$ |
| Compressive strength of M10 concrete brick - | 10$N/mm^2$ (full strength) |

## 4.2 Cost analysis-

### 4.2.1 Cost analysis of single M5 concrete brick –

| | |
|---|---|
| Cost of cement of per kg - | Rs.10 |
| Cost of sand/ fine aggregates per kg - | Rs.2 |
| Cost of coarse aggregates per kg - | Rs.1.5 |
| Quantity of water used - | 0.13L (approx.) |
| Amount of cement used - | 0.25 kg |
| Amount of sand/ fine aggregates used - | 1.25 kg |
| Amount of coarse aggregate used - | 2.5 kg |
| **Average cost of production of M5 brick -** | **Rs.8.7** |

**4.2.2 Cost analysis of single M7.5 brick –**

| | |
|---|---|
| Cost of cement of per kg - | Rs.10 |
| Cost of sand/ fine aggregates per kg - | Rs.2 |
| Cost of coarse aggregates per kg - | Rs.1.5 |
| Quantity of water used - | 0.16 L (approx.) |
| Amount of cement used - | 0.307 kg |
| Amount of sand/ fine aggregates used - | 1.23 kg |
| Amount of coarse aggregate used - | 2.46 kg |
| **Average cost of production of M7.5 brick -** | **Rs.9.2** |

**4.2.3 Cost analysis of single M10 brick –**

| | |
|---|---|
| Cost of cement of per kg - | Rs.10 |
| Cost of sand/ fine aggregates per kg - | Rs.2 |
| Cost of coarse aggregates per kg - | Rs.1.5 |
| Quantity of water used - | 0.2 L (approx.) |
| Amount of cement used - | 0.4kg |
| Amount of sand/ fine aggregates used - | 1.2kg |
| Amount of coarse aggregate used - | 2.4kg |
| **Average cost of production of M10 brick -** | **Rs.10** |

**4.2.4 Cost analysis of red bricks –**

| | |
|---|---|
| Average cost of Class A brick - | Rs.10 - Rs.12 |
| Average cost of Class B brick - | Rs.8 - Rs.10 |
| Average cost of Class C brick - | Rs.7 - Rs.8.5 |

## 4.3 Discussion of results-

As clearly visible from these values, the compressive strength of concrete bricks is better than those of red bricks respectively. Concrete bricks possess better load bearing capacity than those of red bricks and cost of production is almost the same. Also less mortar is needed for concrete bricks hence pulling down the cost of construction. Also it has several advantages like low maintenance cost in high moisture areas, good resistance to winds, sound insulation etc. Concrete bricks can last more time and most importantly they are less likely to get damaged in case of unloading and loading process results in more number of properly shaped bricks for construction purpose. Hence given the scenario concrete bricks have long term benefits at almost the same price of regular red bricks.

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