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ANALYZING ANCIENT METHODS IN THE FIELD OF CIVIL ENGINEERING FOR SUSTAINABLE DEVELOPMENT

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ABSTRACT

In fighting one of the biggest fight of human race, the fight against 'Pollution', the civil engineers and the construction sector needs to do its part to protect and conserve environment. Pollution is inevitable and has been a part of the modern construction field. There are many impacts of construction on environment which have been discussed below. To tackle pollution we can use lime mortar as a binder. Compared to modern marvels which have a lifespan of less than 150 years, we have examples of forts, monuments, religious places, etc. which are living proofs of sustainability. The examples of various monuments where it is evident that lime mortar can be used to tackle pollution, have been discussed below, India has the resources and strength to make the change from cement to lime mortar and can accomplish the first stepping stone to greener tomorrow.

Keywords*: *Ancient Monuments, Construction Sector, Environmental Impact, Lime Mortar, Sustainable Development

I. INTRODUCTION

In the beginning, man started finding shelter in caves and today he lives in buildings which are 800 meters above the ground. Throughout the course of history we have developed our technology and utilization of resources available to improve our living. There are many examples of sustainable development like ancient buildings, monuments, forts, etc. which all have survived till date without much harm. Even though todays construction world has increasing number of types of materials and techniques we are unable to achieve something which has been already achieved thousands of years ago! This millennium has started with an ever increasing speed of technology and science but with a major drawback of pollution. Ironically, the earlier humans were unaware of pollution but still built sustainable structures without creating any kind of pollution and today when we know that climate change is real, we are still heading the wrong direction. So author has shown interest

- To analyze and study the ancient methods and materials used in the field of construction technology.

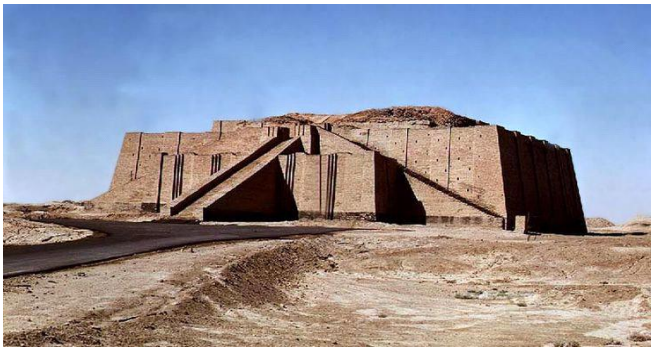
- To study the impact of modern as well as ancient buildings and materials on environment.

II REVIEWING STRUCTURES AND THE MATERIALS USED

2.1 Before the 17th century:

- It is believed that the earliest man (13th century BC) when in search of food and water, settled on the banks of rivers system of Mesopotamia (Iraq) where the first large scale building began. Some of the remains are still intact. *The main material used in that time was mudbricks.*

- *Ziggurat, Mesopotamia [01]*



- In the ancient Egypt, *Adobe; sun-baked mud bricks were used*. These are still used in some rural areas as they are ideal for hot and dry climate.

The Ramesseum in Thebes, Egypt [01]. (13th century BC)

- The biggest achievement in the time of ancient Egypt is the ' Great Pyramid of Giza', the only building which was the tallest on the planet for a staggering 3800 years! It was built completely by stones.

- Pyramid of Giza. (2550 to 2490 B.C.)[02]

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- Similar to the Egyptian and Mesopotamian civilization, *the* ***ancient Greece*** *built their houses with mud-brick*.

- The Roman Empire (1st to 3rd century AD) was the time of birth of lime mortar; It is made of lime, water and sand.

- *Panttheon, Rome(118-128AD)[01]*

- The Great Wall of China (7th to 2nd century BC) was built with stones, *rammed earth*, wood, bricks and tiles with lime mortar. Rammed earth [03] (a technique used to build structures using earth, chalk, lime or gravel) isn't strong as cement but if built properly, it can be used for domestic development with a lifespan of 1000 years.

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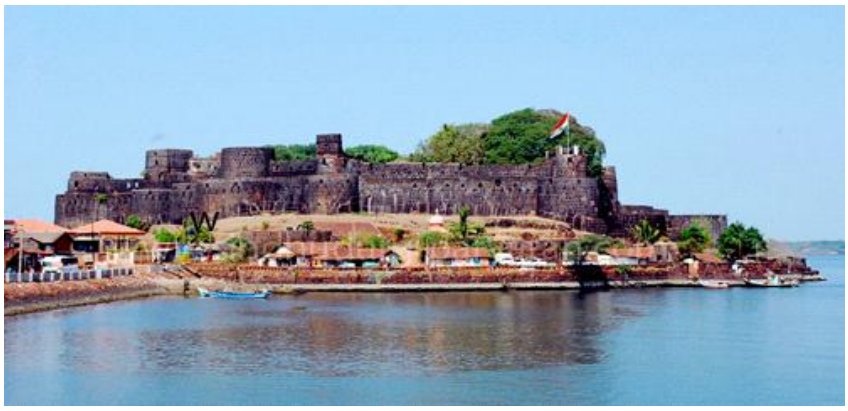
- In 1680, Shivaji Maharaj used stone with lead as binder [04] in building the fort of Sindhudurg which is still standing strong today without any damage.

- Sindhudurg Fort, Maharashtra[04]



2.2 Medieval Age

The medieval ages range from 5th to 15th century AD, where bricks were a major part of construction. The Renaissance was an important chapter in the history of bricks which were then used ever since. The major invention of the seventeenth century was glass. Also use of iron and lime mortar was tried and experimented to repair structures. In the Eighteenth century the field of construction was taken up by professionalism. Iron was tried to make the best of use but was always insufficient to make large structures. Bricks were made in a large number and were coated with lime render (cover of lime mortar)

Tempietto (1502), Italy [01]

Modern Age

The Industrial Revolution in the 19th century and Second Industrial Revolution in the 20th century changed the face of

civil engineering. Construction was not just a need, it was an ever increasing demand. Modern techniques, mathematics, physics all played a vital role in shaping the construction industry. Inspired by the Portland-cement of Roman era, reinforced concrete was invented. It was made by burning finely ground chalk and clay in a kiln until the carbon dioxide was removed to resemble high quality stones found in Portland, USA. Due to the rich knowledge of tensile stress of concrete, it was widely used all over the world.

III ENVIRONMENTAL IMPACT OF CONSTRUCTION

Today we are facing the biggest problem of the history of our planet earth - Pollution! It is an accumulated process which can cause severe problems in the near future. In the field of civil engineering, there are many factors which affect nature. The most important is air pollution followed by water pollution.

- Air pollution: Dust is inevitable on a construction site. Worse than that is the dust classified as PM10 (particulate matter 10 micrometers or less in diameter). It is invisible to naked eye and can travel for long distances. It cause a wide range of lung diseases. Also smoke, vapors from oil, paints, plastics cause air pollution on a large scale.[05]

- Water pollution: Water is polluted with dust, debris, paints, oil on the construction field. This water is lead in streams, rivers and sewages. Soil erosion and soil pollution is also seen which detoriates the soil equality and green cover. Water seeps into the ground and pollutes the ground water. Once polluted, ground water is very difficult to treat.

- Many other factors such as increase in temperature is evident on a construction field. In the making of concrete, an exothermic reaction takes place as water is added to cement. In summer season, cement traps heat inside the building, increasing the average temperature of the place as well as the surrounding.

- Colossal amount of energy is required in the project making process. This energy is supplied mostly with using non-renewable resources.

- About 90% of the material is used. Other is thrown out as waste or rubble. This waste has no applications again whatsoever. We can analyze how much waste material is created in big projects!

IV ANALYSIS

If we do take a certain examples cited above, we can observe that all of them are made with basic materials available, without adulteration, which are mixed together to obtain a certain substance. Consider the Pyramid of Giza, it was built with huge carved granite stones and tura limestone [02]. Without doubting the sustainability of the structure, it is still after thousands of years stand strong without any damages or effects of pollution. Ziggurat of Khorsabad, Mesopotamia [01], built as a dwelling palace of gods, was built by mere mud bricks. The Great Wall of China was

built before the use of bricks in regular construction. It was built using rammed earth and stones. There is neither pollution related to this structure nor does it need much renovation every now and then. The Sindhudurg Fort, Maharashtra, was built using stones and lead as binder. The fort stands right in the middle of the sea facing the high tides and winds for hundreds of years today. Including the fact that building a fort in the sea without the help of technology is surprising, more astonishingly the fort isn't affected by water in any form till date. One of the major attractions of Hyderabad, The Golkonda Fort, was made by using massive granite stones and lime mortar.[06]Standing strong and gaping at the city of jewels from a hill, the fort has been strong against all enemy attacks from 1600s. There are no signs of soil erosion or any kind of harm to the environment from this massive monument.

The Burj Khalifa, Dubai, built in 2012 has a life expectancy of 100 years of functionality. It is a shocking figure to think on as billions of dollars were spent to build the gigantic structure.[07] The Golden Gate Bridge [08], built in 1937, is now expected to be functioning for around a 100 years from today but will be needing indefinite repairs and maintenance to do so.

Today the expectancy of a building is determined by the budget it has for maintenance purposes. There are so many factors that has to be taken into consideration today. Pollution, climate change, exploitation of resources etc, are one of the major issues. Even at the time of building the monuments, much care of the environment, knowingly or unknowingly, was taken.

We have evidences that the monuments, forts, buildings built using the most natural resources have long lived and are still standing strong. The Industrial Revolution demanded and made the construction world to work and find out more economical and efficient ways. The birth of reinforced concrete and steel was due to the increasing demand. Pollution wasn't a part of the problem in the 19th century and it was ignored in the race of development. They were considered as the only solution to the demand. Lime mortar has been used for a long period of time. It has strong armed anyone in the field of sustainability and can answer and solve problems which lead to pollution of the earth.

V DISCUSSION

In search of sustainable development, India can research on making use of lime mortar on a large scale. India has abundance of lime mining sites and can make significant advances in green development. Low level of pollution is observed when the natural resources are used in their most original form. It is important for the human race to start development in the field of green energy as we are heading for an avalanche of problems due to pollution. An initiative is a must in the near future to ensure the survival of human as well as other species on earth. Insensitive exploitation of resources is leading us to a dead end. It was a small mistake on the part of human race in the greed of comfort. Just like a mother let goes a mistake by her child, mother nature will also forgive us if we take a step back and help conserve our natural resources.

VI CONCLUSION

We have strengths and resources to switch from cement to lime mortar. Not a sudden change but an introduction into the civil engineering world is todays need and a possibility. L**ime mortar [09]** is our today's solution to sustainable development. It has a property of self-healing in terms of cracks, whereas cement detoriates and cracks after its lifespan. It is easier and economically better to heal lime mortar than cement. It is very environmental friendly as it reabsorbs the CO_2 released during its lifetime. It does not attract moisture, there is not much need for water proofing [10]. Proven to be effective over thousands of years. One of the best example stand strong still today;

1] Charminar [11], Hyderabad. Made with lime mortar and granite. Built in 1591 (426 years)

2] Qutb Shahi's Tombs, Hyderabad. Built in 1543(474 years) [12]

3] Golkonda fort, Hyderabad. Built in 1600s (400 years) [06]

Map of India showing limestone mines (updated in 2014) [13]

India has 35 limestone mines. It's only a matter of time when we start using lime mortar in small constructions. We use jailhouses that were built by the people generations ago. We can use the same old techniques in a new form to build houses and settlements for the poor who can use them for generations to come without any concerns about the strengths of the building.

In the war against pollution and for the solution to create sustainable development, lime mortar will be one of the greatest weapons.

REFERENCES

[1] https://en.wikipedia.org/wiki/History_of_construction
[2] https://en.wikipedia.org/wiki/Great_Pyramid_of_Giza#Construction_theories
[3] https://en.wikipedia.org/wiki/Rammed_earth
[4] http://www.india.com/travel/goa/places-to-visit/forts-sindhudurg-fort/

[5] http://www.environmentalpollutioncenters.org/construction/

[6] http://www.aponline.gov.in/Quick%20links/HIST-CULT/architecture_qut.html

[7] http://www.archi-ninja.com/burj-khalifa-dubai-the-truth-behind-the-bling/

[8] http://www.foxnews.com/us/2012/05/21/golden-gate-celebrates-75th-with-help-engineers.html

[9]http://www.academia.edu/415892/A_Short_History_of_the_Use_of_Lime_as_a_Building_Material_Beyond_Europe_and_North_America

[10] http://www.chapelgatehome.uk/our-blog

[11]http://timesofindia.indiatimes.com/city/hyderabad/The-worlds-first-lime-mortar-building/articleshow/1890818895.cms

[12] https://hyderabadadvisor.com/qutub-shahi-tombs/

[13] http://www.mapsofindia.com/maps/minerals/lime-stone-mines-map.html