

Laboratory Analysis of The Physical Properties of Papercrete

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Abstract- Papercrete is a mixture of cement, sand and paper. When combined and cured, these materials produce a product similar to concrete; however, it is very lightweight. Additionally, the cost efficiency gained by utilizing the sufficient supply of recycled paper reinforces the need for the research of this alternative material. All elements of the structure have different strength requirements.

I. INTRODUCTION

The environment impact of paper is significant, which has led to changes in industry. With the use of modern technology, hence capturing carbon dioxide emission by using waste as raw material. Papercrete is an emerging new concept however it has limited scope (Arjun Dileep et al, 2021).

“Sustainability” is nowadays one of the most used but least understood terms since usually there is the tendency to treat this matter in a superficial way interpreted under different points of view, and linked to “eco”, “green”, or “smart” rhetoric. In general, the concept of sustainability is aimed at ensuring the quality of life and linked to three areas: environmental, sociocultural, and economic. For these reasons, engineers have to consider a building’s “lifecycle” cost, from the building construction and maintenance to demolition and recycling, extended over the useful lifetime to comply with sustainable standards. In particular, to build in a sustainable manner there is the need to pay attention to physical, environmental, and technological resources, together with problems related to human health, energy conservation of new and existing buildings, and control of construction technologies and methods. Actually, there is the need for a new generation of ecological materials able to improve durability and energy efficiency and to allow waste recycling and cost savings (Tiziana Cardinale et al, 2021).

Significance study Since 20th century, plastics have been used progressively in a huge range products because it satisfactory, like low density, high strength as compare weight, high durability, easy to manufacture & design & low cost. Currently plastic products are usually used in almost all field, particularly in packaging, building & construction,

automotive, electrical & electronics, agriculture & or industries. worldwide plastic production in 2012 is reported to have increased to 288million tons (Europe, 2013). In whole consumer products half this amount were used one f disposal. It produced very large & nondegradable plastic related waste. Most types plastics are not biodegradable & are chemically uncreative in natural environment; hence, such polymer products persevere decades, even centuries. basic common type plastic component like Polyvinyl Chloride (PVC) & Poly Carbonate (PC).

studyIn current period time, waste material is very serious problem & plastic product is widely used in whole world that reason it requires to decomposed or recycle plastic material. Its also affected atmosphere, soil, water, & human. To protect all se, we have to recycle & decomposed plastic material in new product. To save nature we have study & resolved worldwide problem. In my sis work we studied about glass bottle & also studied about it with . 1.5 Objectives main objective set this research is to study improvement strength conventional using recycled plastic bottles.

A cement is a binding material which is med by crushing, burning & n grinding stones clinkers se clinkers are med by siliceous, argillaceous & calcareous stones. Cement provides binding property by process heat hydration with help water, now a days cement is broadly used material on earth. various uses cement are bonding bricks, plastering walls, preparation base foundation, flooring work, grouting work & final finishing.

II. LITERATURE REVIEW

Concrete is one of the most widely used construction material in the world and it must keep evolving to satisfy the increasing demands of all its users. The emission of CO₂ from cement production is a major issue for all the countries. Also the majority of abandoned paper waste accumulating from all over the world causes certain serious environmental problems. The present study focuses on utilizing the materials like fly ash and lime in papercrete bricks, thereby reducing the amount of cement in the bricks and also to reuse the waste papers

without causing any environmental issues. Experimental investigation was carried out to evaluate the compressive strength, water absorption and dry weight of fly ash - lime based papercrete bricks. The maximum compressive strength is obtained for 20% replacement of cement with fly ash and lime respectively. The test results shows that, further replacement of cement with fly ash and lime decreases the compressive strength & increases the water absorption of papercrete bricks. Papercrete bricks are light weight and relatively more economic and they can be used for partition walls & non load bearing walls (Arjun Dileep et al, 2021).

The manufacturing of Portland cement is responsible for a big amount of energy and greenhouse gas (GHG) emission. Therefore, to date, it is imperative to find alternative materials to replace a major part of cement for sustainable concrete constructions. The present study forms a part of an on-going research project on the application of new cementitious matrices produced using different types of recycled materials. In particular, it focuses on the use of pulp and waste paper to partially replace Portland cement at varying percentages for producing a new lightweight mortar, frequently named papercrete. The development of this economical and eco-friendly material may permit of recycling a big amount of waste paper leading to lower housing costs with also ecological benefits. To this scope, an experimental campaign in the laboratory is carried out to characterize this new innovative material from a physical and mechanical point of view. The preliminary results of this on-going experimental campaign are illustrated and commented on in this paper. The obtained results confirm the possibility of applying this partially-recycled material as a possible alternative for strengthening existing panels of masonry (Tiziana Cardinale et al, 2021).

Earlier beginning of the laboratory studies for the assessment of alternative green building materials, a literature study was conducted to gather information about the strength and weaknesses of using Papercrete and Papercrete blocks with varying ratios of the paper to sand (fine aggregate) and binding material (cement). Cement, sand, coarse aggregate and water are the materials to make concrete. The waste paper has been dumped as waste and causes environmental pollution behind mill or landfill. The industry paper wastage for every year is increasing gradually. More spaces are being needed for landfills, uses energy loss of natural resources and increase of expenditure and various types of pollutions. Utilizing waste paper as cement replacement or addition in concrete production will reduce environmental pollutions. This review paper is to investigate the effect of waste paper on mechanical properties of concrete such as compressive strength and flexural strength. From many previous studies before this, 5%

and 10% waste paper as cement replacement and additions were the ideal percentages to increase the compressive and flexural strengths of concrete. This study indicates waste paper can give benefit by using it as additional material in concrete production Solahuddin B. A. et al, 2021).

Papercrete is a modern composite material, that uses waste paper as a partial replacement to Portland cement, and is a renewable medium to construction owing to the reduction of the volume of waste paper as well as cement. Papercrete has strong sound absorption, thermal insulation and a low-cost alternative; light weight and fire-resistant building material. However, its low mechanical strength needs to be compensated by incorporation of supplementary cementitious materials. The work discusses the potential for the partial replacement of cement (by weight) with waste paper pulp in presence of Rice husk ash (RHA) and fly ash (FA) in ternary blends. For tests, the levels of replacement for RHA and FA were 10%, 15%, 20% and 25% and for waste paper, the rates of replacement were maintained at 10%. A reference mix was also prepared for the comparative purposes without substitution by RHA, FA and paper pulp. The flow, compressive strength, split tensile strength, water absorption and dry density studies were performed for all the specimens. The findings revealed decreased the flow of specimens compared with the reference mix along with reduction in strength that was well compensated by RHA and FA particles. The optimal content for RHA blends was 20% and that of FA was 15% with maximum strength among the mixes. The study signifies that the waste paper can be used to prepare papercrete in presence of optimal content of supplementary cementitious materials to have desired mechanical properties (A Singh et al, 2020).

Papercrete is a complicated term. The name seems to involve a mixture of waste paper and concrete; hence it is called as papercrete. Different types of papercrete contain 50% to 60% of waste paper (K. Anandaraju et al, 2015). Up to this instant, there is no hard and fast rule, but recommended standard will unquestionably be established in the future. The India faces two important challenges concerning the environmental sustainability. First one is the energy utilization in every building every part of over the country. This can post a massive advantage for our population in the reducing energy poverty. Since buildings cause greenhouse gas emission, proposed energy reduction measures must be considered. In new building constructions, there should be at least an innovation to reduce this kind of environmental trouble that arises when there are new building projects. Our non-renewable resources are soon to disappear if construction materials mainly depend on these resources. Process and commercialized products raise their demand, philosophy that

these are more capable for use in its place of the alternative ones.

Initially patented in 1928, papercrete was very complicated to promote because it was so easy and inexpensive (Solberg 1999). After the creative patent, the idea of papercrete remained hidden until the 1980's. Since this time, many people have used the material to construct houses and other buildings. Because the holders of these houses do the majority of the work themselves, the cost estimates only include materials, not the cost of manual labour. These holders or landlords shared their knowledge permitting others to use the same techniques to construct their own houses. As the knowledge was passed from one person to the other person, many different methods were used to construction of various building techniques and thoughts. Even the name of the material differs from one builder to the other, some people's calling it papercrete whereas others call it fibrous cement. Papercrete has been used in numerous ways with a variety of the techniques. Over the years, papercrete has changed significantly.

III. EXPERIMENTAL METHODOLOGY

3.1 GENERAL

The green construction materials were tested in this research study using an experimental technique. The group's purpose was to develop a new construction material that would maximise the use of commercially accessible materials such as sand, cement, gravel, and other building materials. Several concerns, norms, and constraints must be examined in order to provide another type of material that can be used in construction. One of the characteristics to consider is the stiffness of the material, which should be strong and allow little slack for interior walls for better insulation. Another thing to think about is the durability. The material should be durable in the sense that it can survive certain living conditions while also being long lasting, with a suitable life expectancy for the material to be localised. Finally, a light-weight construction material with comparable strength should be considered.

There are a variety of factors that could impair the material's stability due to the localized character of modern construction materials. In order to apply it consistently, parameters should be examined first before being implemented in any section. Climate variation should also be considered; comparing our climate to those of areas with much lower temperatures may result in unpredictably unpredictable changes and variances due to environmental components and reactions as a result of weather changes. Constituent resistance

may be incorporated as well because this construction material isn't covered by our National Building Codes (NBC) or other sources, necessitating additional research to achieve a specific purpose.

3.1 Research status in the field of papercrete

There have been no profitable applications for papercrete till recently. Expanding the size of the structures to cover the piles is difficult because they are made of papercrete. This method will be greatly influenced by the weather. As previously mentioned, the tamping process was repeated. The 0.75 inch rod was used to level the papercrete to the rim of the mould and turn over the extra papercrete from the top of the mould. This approach was followed each time a cube or cylinder mould was created, resulting in a standardised method for creating test specimens. For concrete strength testing, all prepared specimens were set according to Indian Standards.

For the next 24 hours, the cube and cylinder samples were left in the moulds to set. The samples were then taken from the forms at this point. After then, the samples were put in the same order in which they were poured. Curing and drying the prepared samples was the next step in the operation. Because cement hydration takes a long time, the samples needed to keep moist in order for the hydration process to complete. The time it takes for papercrete to dry naturally varies depending on the composition. The drying of the papercrete and the curing of the cement happen at the same time. In most cases, the drying time was longer than the curing time of 28 days. After the samples had dried completely, they were analysed. When the sample weight stabilised, the drying period was finished. The results of the drying time can be seen in the appendix. The test samples were kept in the lab during the curing process, which may have shortened the drying time as compared to an outside setting where humidity fluctuates often.

Nano silica particles in concrete saves the resources and energy as well as it protects the environment from the pollution with the reduction of waste material and reduction of CO₂ emission. The research work concern with the use of Nano silica in concrete and to improve the compressive strength of concrete of M20 with water cement ratio 0.42. This paper shows the partial replacement of cement with the Nano silica with different doses like 0%, 0.5%, 1%, 1.5%, 2%, 2.5% and 3% by weight of cement and increase the strength property of concrete and also shows that the comparative study between the concrete without addition of Nano silica and with addition of Nano silica. The result of this research paper is, the enhance in the strength of concrete by the

application of Nanosilica. One of the major flaws in the system which was found was that the public transit system of the road connectivity to the metro stations isn't able to meet the demands of the ever exploding population in these cities. By those service providing where the quality criteria are not clearly defined is the board of customers satisfaction defining greater problem. As such, much research and revenue has been invested in developing accurate ways of assessing consumer satisfaction at both the macro (national) and micro (organizational) level, facilitating comparisons in performance both within and between industries. In the field of public mass transport wherever could be a heap of various customers located whose expectation and vision concerning quality of service that they require to use, aren't forward specified, their demands produce an excellent combination. Each of us, users of those services, is in a position to outline own expectations alone, however the expectation of resident might be significantly completely different, thus we arrange four completely different age groups as mentioned within the abstract earlier, and carried out a systematic and convenient information. we listed some points that justify our would like of study that's conniving client satisfaction publicly transport. These are as follows: The levels of service in terms of journey and waiting time, onboard crowding, reliability, etc. are not satisfactory In this world of advance technology people want an advanced transport system with modern amenities and if these amenities are not provided to their satisfaction level related to any one transport medium goes down and this is our main point of consideration. Ineffectiveness of bus lanes during peak hours .Increased vehicle intensity has caused a huge congestion in traffic facilities, specially the crowding up of lanes. Hence in order to get a smooth traffic flow more no. of lanes must be given. Transfer tickets are not available and often transfer points to other routes are not direct and convenient All the busses in a single registered transport network should be interlinked at some particular and defined points so that a person can transfer himself one route to other route at any instance if needed.

3.2 Selection of the Proportion

Normal concrete testing was used to establish the material and structural qualities of the Papercrete in order to explore its behaviour and strength capabilities. We chose different specimen ratios in order to collect comparison data and assess how they varied from one another. We may now conclude and easily say which ratio best suits the Papercrete idea and its properties as the concrete established, based on those data.

3.3 Making of Paper Pulp

Initially, we gathered recycled papers such as newspapers, discarded official papers, old exam papers, and anything else made of fibrous elements, particularly papers. Weighing paper samples was difficult because they were damp after being soaked for 24 hours.

The next step was to soak the paper samples for the following 24 hours in order to soften the fibrous composites and make mixing easier. (Grosse, C.U., Ohtsu, M., 2008). After soaking the paper sample in water for 24 hours, the paper sample was prepared for re-pulping by mixing the soaked paper until it became fine and produced a homogeneous pulp.

If the buses designed are bulky then traffic congestion happens and if buses are too short then no. of passengers carried will be too less and thus the phenomenon of overcrowding occurs. Frequency of service and schedule is not strictly adhered The buses should necessarily be rotated according to the schedule designed so that the passengers may become aware of the general timings of a bus on any route. Moreover the frequency of services should also be kept in mind so that a passenger should not be forced to wait for a long time period if he/she misses a bus accidentally. Terminal facility are not optimal Terminal facilities should be paid attention to and strictly taken care of in order to facilitate the passenger and in turn facilitating the whole bus transport network. With the aim of quantification of customers views for his or her desires or expectations level of performance with providing service (with the target of constant improvement) is feasible to use supposed client Satisfaction Index CSI. there's necessary to outline what we'll perceive underneath the quality. The CSI model consists of variety of latent factors, every of that is operationalised by multiple indicators. client satisfaction are often outlined as associate overall analysis of a firms post purchase performance or utilization of a service. its at the core of the CSI framework and is sheathed inside a system of cause and result running from the antecedents of overall client satisfaction expectations, image, perceived quality and worth to the results of overall client satisfaction client loyalty and client complaints. the plain strength of this approach is that it moves on the far side the immediate consumption expertise and facilitates the study of the causes and consequences of shopper satisfaction. In fact, the first objective of this structural approach is to clarify client loyalty. client satisfaction index is additionally referred to as the voice of the client. there have been developed variety of national policies and approaches to the calculation of the index. Simplified approach are often used {individually separately singly severally one by one on associate individual basis} for every carrier that has an interest in assessing the standard of their product transport services One of the most important

aspects of the research is the composition or proportion of the various elements used to make the papercrete used for the building. The material qualities must be determined in order to see if massive constructions may be built out of papercrete. As a result, the compressive and split tensile strengths of five different papercrete formulations were determined. The number of compositions was decreased from five to one as a result of this technique. Different proportions of paper, sand, and cement were employed in the papercrete combinations that were evaluated. The amount of water used in the mixture varied in order to keep the viscosity steady and ensure good mixing.

In a concrete, after aggregate and cement, water is most important component. Water and cement are responsible for binding everything. Thus water/cement ratio plays a very vital role in any construction. For high strength concrete 0.4 w/c ratio is desired. For ordinary concrete w/c ratio between 0.60.7 is normal. A higher water cement ratio makes the concrete structure weaker. India is well on its way to become a world power by the year 2050 and what is a superpower while not a consistently mobilized residents. With the rise in population in cities, its been need of the hour to create new ways that and integrate the already existing systems within the transit state of affairs. Republic of India (like several alternative developing countries) however has lagged behind in developing the subway rail transit system for its ever growing population While researches show that the best modal share of conveyance ought to be around seventieth, but its in tune to only 35%40% in Indias metro cities. this is often but because of the actual fact that theres no productive linkage or connectivity to the most areas of town by the subway railway line and therefore the transit system makes use of this disadvantage to monetise on its own property. A productive town invariably makes use of the simplest of its resources with nice engineering at the side of reaching to lay out a fantastically and well thought structured town with its resources operating for every alternative. In my very own expertise of being in Old Delhi for a substantial quantity of your time, I even have stumble upon loads of issues that the town poses once it involves the property and linking of the roads to the railroad line stations. A bus stop is usually set removed from the railroad line station that accounts for the waste in time to travel to railroad line station on foot. It additionally created some discomfort and as a traveler I typically took the lighter approach of travelling thats by taxi or rickshaws. If in associate degree case its an emergency it may case larger discomfort on behalf of me for the number Im finance in my commute. Loads of those issues square measure the foundation reason behind one issue thats the urban planners typically dont think about the varied aspects once it involves coming up with out the road transit system in our

cities. With some minor corrections and major changes within the approach our transit system is planned a traveler will increase his quality of life by an excellent deal as around halfhour of the time a operating person/citizen spends in travelling or motion at intervals a town. Even the delhi metro that is taken into account to be the foremost eminent in our country is merely moderately eminent. Within the domestic situation, there arent terribly economical transit systems in india. Before delhi subway system came into being, there was only 1 town that has railroad line system i.e Calcutta that has been operational since 1984. Its been over twenty five years currently and there has been major talks for a mass rapid transit system around then however it solely came into being in 2002. a very highly eminent system of transit by rail system is that the mumbai suburban Railway, popularly referred to as the mumbai local, however its not as subtle as one would need throughout the commute. Major cities like city, Mumbai, Gurugram, Jaipur, Chennai, Kochie and Lucknow are another cities with metro mass rapid transit system.. Metros in these cities are only recent developments and dont service a large space and thence have low ridership. Its terribly early to evaluate the success of those railroad line systems. In this paper, a study has been conducted supporting the prevailing railroad map of Bhopal and a perspective for a cheap transit system to travel with the approaching railroad rail project is planned. Most of the study here relies on my terribly own studied associated well thought views and that i conceive to return up with an emerged perspective of however the transit system need to be changed for higher to higher comfort of the passengers therefore on avoid the failure of the project. the necessity of client Satisfaction Index plays a really necessary role altogether of this thanks to the particular undeniable fact that the whole project success relies on account of the frequency of usage of such transit system that is subway confine Bhopal. The index permits service quality to be monitored, the causes generating client satisfaction/dissatisfaction to be notable, and thus the ways that for rising the service quality to be made public. The projected methodology show some blessings compared to the others adopted for mensuration service quality, as a result it is merely applied by the urban planners. even have} to put a disclaimer that none of the CSI study is directly connected to what I actually have planned but it merely acts as a proving purpose altogether of the study.. 3 India is well on its way to become a superpower by the year 2050 and what is a superpower without a systematically mobilized citizens. With the rise in population in cities, its been would like of the hour to create new ways in which and integrate the already existing systems within the transit situation. India (like several different developing countries) however has lagged behind in developing the railway rail transit system for its ever growing population. Research shows that the best modal share of

transport that is that the MRTS ought to be around 70%, but only 35%45% is that the achieved quantity in Indian metro cities. This can be but because of the actual fact that theres no successful linkage or connectivity to the most areas of town by the railway railway line and also the transit system makes use of this downside to monetise on its own property. A prospering city perpetually makes use of the most effective of its resources with great

3.4 Selection of the composition for Papercrete

To establish the physical qualities of papercrete, a variety of formulations were investigated. In each mixture, the percentages of paper, cement, and sand were changed. The C S of five distinct mixtures was determined. The precise compositions were chosen to generate a range of strengths, allowing us to decide the most cost-effective and feasible mixture for building construction.

More concrete added enhances the strength more than the other two components because the concrete mixture created bonding between the paper strands. Concrete, on the other hand, was more expensive than paper and sand, therefore cost was directly proportional to strength. The paper was utilised as a light-weight "filler material," improving the volume and lowering the cost of the building material. The papercrete becomes weaker as more paper is used.

Table- 1 Selected composition for papercrete

S. No.	Sample	Ratio		
		Paper pulp	Cement	Sand
1	Mix-I	1	8	1
2	Mix-II	2	6	2
3	Mix-III	3	5	2
4	Mix-IV	4	4	2
5	Mix-V	5	3	2

We select these five different proportions after various literature reviews for testing the C S of papercrete and split tensile strength of papercrete.

IV. MAKINGOF SAMPLE AND TESTINGMAKINGOF SAMPLE AND TESTING

4.1 SAMPLE PREPARATION

1 kg of paper pulp, 8 kg of cement, and 1 kg of sand were used in the Mix-I sample. The amount of water added varied based on the mixture's necessary workability. It was not

safe to specify the amount of water because the paper pulp already contains water that may vary throughout the mixture due to the lack of knowledge and qualities of papercrete. The amount of water used was determined by the mixture's workability.

The cube and cylinder moulds used in the experiment are 150 mm x 150 mm x 150 mm in size, and the cylindrical moulds are 150 mm in diameter with a height of 300 mm. Paper pulp, cement, and sand were combined in the desired amounts. The mixture was thinned with water until it was more workable. The operation had to be repeated from the beginning due to too much water being added, with measurements conducted to accurately quantify the amount of water delivered to each and every sample test.

Significance of study Concrete is a blend of CA, FA (sand), admixtures and water. Today Global Warming (GW) and environmental pollution have become manifest harms in early and recent years, concern about environmental issues. It can happen due to use and production of the mass unused, mass consumption, mass production. Normally it can see that glass does not harm to environment due to not produced pollutants matter but it can harm animal as well as human shortly when we do not take care off that time it harmful and it is not non biodegradable. For that we required new technologies to overcome them from this problem. The glass has many chemical diversities like Soda lime Silicate Glass, Alkali Silicate Glass & Boro Silicate Glass. These all types of glasses generally used in Civil Engineering work as Pozzolana. The Alkali contents increases the of cement. It also used in brick manufacturing & ceramic manufacture. The useful and recycled materials, glasses and GP are mainly used in various Civil Engineering project because GP as supplementary cementitious material and CA. All type of glass is near to 100% recyclable. It also increases concrete durability without affects any property in concrete. In recently glass & GP has used as a construction material for reducing environmental pollution. In concrete mixed the coarse & fine glass aggregate produced Alkali Silica Reaction (ASR) but this problem can not happen in the case of GP because it has Supplementary Cementitious Material (SCM). Therefore, GP used as replacement of SCM.

The levels of service in terms of journey and waiting time, onboard crowding, reliability, etc. are not satisfactory In this world of advance technology people want an advanced transport system with modern amenities and if these amenities are not provided to their satisfaction level related to any one transport medium goes down and this is our main point of consideration. Ineffectiveness of bus lanes during peak hours .Increased vehicle intensity has caused a huge congestion in

traffic facilities, specially the crowding up of lanes. Hence in order to get a smooth traffic flow more no. of lanes must be given. Transfer tickets are not available and often transfer points to other routes are not direct and convenient All the busses in a single registered transport network should be interlinked at some particular and defined points so that a person can transfer himself one route to other route at any instance if needed.

4.2 MAKING OF PAPERCRETE CUBE AND CYLINDER

The produced mixture was poured into moulds to make cubical blocks and cylindrical moulds, which were then tested for compressive and split tensile strength subsequently. To produce the desired shape and dimensions, the papercrete mixture was poured into metal cylinders and a cubical mould. The specimens were taken from their moulds after 24 hours of concrete pouring and allowed to cure by immersing them again in a bath of water before being tested for physical strength.

Argillaceous and Calcareous stones cement play binding role in concrete mixture while water is added in concrete mixed. Ordinary Portland cement, rapid hardening cement, high alumina cement, super sulphated cement etc. are different types of cement available in the markets and it used different site condition and different desirable purposes.

3.2.1.1 Cement Compounds In Civil Engineering Construction Portland cement is primary material spread in the world. It has 4 principal compounds which known as clinker factors (C3S, C2S, C3S and C4AF) [26] respectively. These compound present in the range of 4560 %, 1530%, 612% & 68 % respectively. The C3S and C2S compound are provide strength in the cement paste for that reason it is more important to another compound. These all compound responsible for strengthening of cement at different ages of water curing.

Human civilization, indeed the most specific one created in nature's history, the one who can think and use the accessible resources for his or her betterment and welfare. however this advanced creature also faced a large problem when it comes to migrate from one place to a different. it had been a large chaos when transferring any significant object from one place to a different. then again happened one amongst the most ancient and important inventions of all time the invention of wheel. Everything became really easy and convenient. All the work created simple and less time consuming. however it had been simply a beginning, giving birth to a foundation to an excellent and massive transport system that we have a tendency to see nowadays around us.

No one thought that the travel might become really easy and convenient. on the other hand a brand new page supplemental to human civilization bright journey the pages that enlisted 2 Brobdingnagian pillars of development i.e. industrialisation and urbanization. These 2 revolutionary stages took the invention of a mare wheel to automobile eternity. currently days we are able to roughly imagine our life while not transportation facility. However during this advanced era of transportation, in proven, welltried to be quite costly for the middle category & the lower class individuals. Then the idea of conveyance was introduced around that our analysis revolves. a rise in population generates increasing in travel demand. Bhopal as one of the most inhabited town within the state MADHYA PRADESH. It faces an outsized range of travel demands. Nowadays, Bhopal deals with an explosive growth in vehicle possession and utilization. an multiplied road length and new roads generate quicker and longer journeys, a lot of journeys by automotive and better automotive ownership all of which adds up to a lot of traffic jam and pollution. Public conveyance is one necessary resolution for this drawback. conveyance operators are forced to put stress on the monitoring observance of the services provided in an endeavor to handle the increasing rate of automobile possession. Additionally and a lot of government organizations, universities, researchers, consultants, and personal industrial teams round the world have become really multimodal in their orientation and are opting a scientific approach to transportation issues. Transportation plays a serious role within the development of the human civilization. as an example, one might simply observe the sturdy correlation between the evolution of human settlement and therefore the proximity of transport facilities.

4.3 Testing of Papercrete specimen

4.3.1 C S Test

The C S of Papercrete was the topic of this study. The capacity of the Papercrete specimen at compression point was evaluated for this. Sample specimens are evaluated after 7, 14, and 28 days to provide comparative data on how Papercrete's behaviour changes over time.

The C S of the prepared specimens was tested in the laboratory. The compression testing machine (CTM) was used to conduct the test, and the results of numerous specimens were recorded for subsequent examination.

4.3.2 Split Tensile Strength Test

On cylindrical samples with a diameter of 150 mm and a height of 300 mm, a split tensile strength test was

performed in the laboratory on a compression testing machine (CTM). These sample specimens are also evaluated after 7, 14, and 28 days to obtain comparative data on how Papercrete's behaviour changes as it matures (Mindess, 2004).

The split tensile strength of the papercrete was determined using a cylinder splitting test. The tensile strength was determined using the same data and equipment as the C S test. A cylinder was positioned horizontally in the actuator to evaluate the split tensile strength of the papercrete. The actuator was programmed to load the sample at a steady rate. The cylindrical specimen was subjected to a force in order to conduct the test.

V. RESULT AND DISCUSSION

5.1 C S Results

Prepared samples having varied ratios of combinations from paper pulp, cement, sand, and water are examined according to their unique time of settlement. Each sample is evaluated until it fails to determine its capacity to withstand a considerable amount of stress; otherwise, it would not be included in the recommended ratio for structural construction.

5.1.1 Test Results after 7 days curing

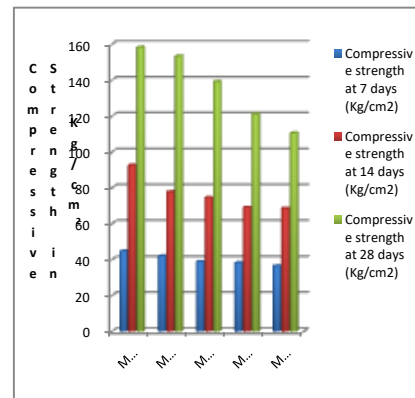
The maximum C S of ordinary Portland Cement Concrete is in the range of 200 Kg/cm² - 210 Kg/cm². The data acquired in the experiment was compared to ordinary concrete, which helped to answer the question of whether or not papercrete would be practicable for structural building.

While we've chosen five distinct ratios for which we've prepared three samples each, we've chosen 1:8:1, 2:6:2, 3:5:2, 4:4:2, and 5:3:2. Mix-I, Mix-II, Mix-III, Mix-IV, and Mix-V are the mixes that we have focused on. The following Mixes were created after a thorough review of the relevant literature. As a result, we've created mixtures that may be used to test the efficacy of paper pulp and cement when blended.

Table-2 Combine results of C S after 7, 14 and 28 days for all Mixes

S. No.	Mix	C S at 7 days (Kg/cm ²)	C S at 14 days (Kg/cm ²)	C S at 28 days (Kg/cm ²)
1	Mix-I	44.67	92.65	158.30
2	Mix-II	42.03	77.71	153.43
3	Mix-III	38.82	74.55	139.19
4	Mix-IV	38.19	69.08	121.10
5	Mix-V	36.47	68.57	110.57

Graph-1 Combine results of C S after 7, 14 and 28 days for all Mixes

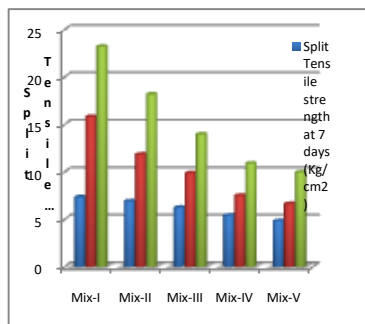


5.2.1 Results of Split tensile strength after 7 days curing

Table-3 Combine results of split tensile strength after 7, 14 and 28 days for all Mixes

S. No.	Mix	Split tensile strength at 7 days (Kg/cm ²)	Split tensile strength at 14 days (Kg/cm ²)	Split tensile strength at 28 days (Kg/cm ²)
1	Mix-I	7.34	15.82	23.20
2	Mix-II	6.91	11.84	18.18
3	Mix-III	6.25	9.88	13.96
4	Mix-IV	5.42	7.50	10.89
5	Mix-V	4.83	6.63	9.97

Graph-2 Combine results of split tensile strength after 7, 14 and 28 days for all Mixes



VI. CONCLUSION AND RECOMENDATION FOR FUTURE WORK

6.1 Conclusion

This research work targeted to develop a new eco-friendly and green material which possibly will be better for the construction activities. With To characterize the Papercrete construction blocks and panels, investigational methods were carried out. Significant possibilities exist to boost the use of this green and eco-friendly material composed of paper pulp to replace a proportion of cement and sand, which are currently widely commercialized. Papercrete is an experimental material that is nearing standardization and definitive finalization, and it may be useful in the development of architectural conceptions. Despite the fact that there is limited information available about this material, ongoing research is being conducted by individuals from various locations who have chosen to localize their personal concepts and arithmetical values in order to accept the unique concept based on their situation, such as climatic conditions and other significant factors.

In order to achieve and determine the most efficient mixture of this newly produced construction material, we ran several different tests and samples with various proportions and proportionality. To have an acceptable description of what is efficient to employ from those evaluated ratios, physical, economic, environmental, and building aspects were also incorporated

Based on the test result of our study, it was concluded the following things:

1. The production of light-weight materials Papercrete is a simple material that is 50 percent lighter than a traditional concrete specimen of the same volume.
2. After a long curing and drying period and necessary adjustments on consolidating the material to perfectly eliminate air gaps from the specimen, papercrete has

a lower C S, reaching only 50% of that of ordinary concrete mix.

3. After reviewing the test results, we discovered that improving the cement concentration in the mix increased the compressive and split tensile strength.
4. When compared to traditional cement concrete combinations, the workability of the papercrete mix is virtually equal.
5. It is difficult to standardize since the behaviours of the paper mixture or pulp are not consistent and unexpected.
6. More research is needed to establish the exact composition for this difficult material that could be possible for development.
7. Papercrete is a good construction material in general. The material's applicability is limited, and its qualities aren't clearly established at this time.
8. By using waste papers and materials in the production of papercrete, landfills and pollution are reduced.
9. The structure's self-weight will be reduced by using papercrete and papercrete blocks.

6.2 Recommendation for future work

These are some recommendation for future work in this field.

1. Comparative cost analysis could be done on papercrete and conventional concrete.
2. The effect of superplasticizer on the various properties of papercrete could be analyzed.
3. More research into the best ways to employ papercrete in building structures should be undertaken.
4. It is advised that a prototype project using papercrete be built in order to estimate labour and material costs.
5. A thorough investigation of the long-term characteristics of papercrete is also required

REFERENCES

- [1] C.R. Taylor, "Building for Free" Building Research and Information. [https:// www.rbri.co.uk/](https://www.rbri.co.uk/) Vol. 40, 2013.
- [2] American Concrete Institute. (2004). ACI Manual of Concrete Practice, ACI International, Farmington Hills, MI.
- [3] Fuller, B. J. (2004). "How to Build with Papercrete, Fibercrete or Fibrous Concrete," <http://www.livinginpaper.com/index.htm>.
- [4] Solberg, G. (1999). Building with Papercrete and Paper Adobe, Remedial Planet Communications, Radium Springs, NM.

- [5] Fintel, M. (1985). Handbook of Concrete Engineering, Van Nostrand Reinhold Company, New York, 169-179.
- [6] Make Papercrete. <http://makepapercrete.com/What-is-Papercrete-.htm>
- [7] Grosse, C.U.; Ohtsu, M. - Acoustic Emission Testing, Basics for research- Applications in Civil Engineering, Springer – Verlag Berlin Heidelberg, 2008.
- [8] Mindess, S. - Handbook on Non destructive Testing of Concrete, Chapter 16 - Acoustic Emission Methods - University of British Columbia, CRC Press LLC, 2004.
- [9] Acoustic emission monitoring of cracking in reinforced concrete specimens, 2nd International Symposium on Advances in Concrete through Science and Engineering, 11-13 September 2006, Quebec City, Canada.
- [10] Determination of bond and flexural strength of reinforced concrete by acoustic emission, Proceedings, 2006-NDE-Conference on Civil Engineer, St. Louis, Missouri, SAD, 2006.
- [11] Study of Lightweight Concrete Behavior, N. B. Manaf.
- [12] Chien, N., Feng, Y., Wang, H.-J., and Siao, T.-T. (1951). Wind-Tunnel Studies of Pressure Distribution on Elementary Building Forms, Iowa Institute of Hydraulic Research State University of Iowa, Iowa City, 10-113.
- [13] Hassoun, M. N. (2002). Structural Concrete Theory and Design, Prentice-Hall, Inc., Upper Saddle River, New Jersey, 17-19.
- [14] G. V. S. Siva Prasad, P. Padmanabha Reddy, M. Swathi, P. D. V. Kiran Kumar, T. Praveenraja and M. Naveen, (2015), Study and behavior of some properties of papercrete brick with modular brick, International journal of Engineering Research, Vol.3, Issue3.
- [15] K. Anandaraju, B. Jose Ravindra Raj and R. Vijaya Sarathy, (2015), Experimental investigation of papercrete brick, IJMCE, Vol. 2, Issue 2.
- [16] H. Yun, H. Jung and C. Choi, (2007), Mechanical properties of papercrete containing waste paper, 18th international conference on composite materials, Architectural Institute of Korea, Korea.
- [17] Shivangni Khandelwal, Kishan Lal Prajapat and Mukul Kumar, (2015), Review on papercrete, IJCRD, Vol. 4, Issue 6.
- [18] Ms. S. Suganya, (2012), Lightweight bricks- made up of waste papers, International Journal of computer and organization trends, Vol. 2, Issue 2, No. 2.
- [19] Isaac I. Akinwumi, Olasunkanmi M. Olatunbosun, Oluwarotimi M. Olofinnade and Paul O. Awoyera, (2014), Structural evaluation of lightweight concrete produced using waste newspaper and office paper, Civil and Engineering Research, Vol. 6, No. 7.
- [20] Joo Hong Chung, Byoung-Hoon Kim, Hyun-Ki Choi and Chang-Sik Choi, (2000), Development of papercrete due to paper mixing ration, International Conference on Sustainable Building Asia, SB10 Seoul.
- [21] T. Subramani and V. Angappan, (2015), Experimental investigation of papercrete concrete, IJAIEM, Vol. 4, Issue 5.
- [22] Yun H., Jung H., Choi C., “Mechanical Properties of Papercrete Containing Waste Paper”, Architectural Institute of Korea, 2007.
- [23] Solahuddin B. A., Yahaya F. M. “A Review Paper on The Effect of Waste Paper on Mechanical Properties of Concrete” Materials Science and Engineering pp 1-7 1092 (2021).
- [24] Arjun Dileep, Atheesh Lal, Jesna Jamal, Adila Abdulla Kunju “An Experimental Study on Papercrete Bricks Manufactured using Paper Pulp, Lime and Fly Ash” International Journal of Engineering Research & Technology (IJERT) Vol. 10 Issue 06, June-2021 pp 968-974.
- [25] A Singh, S Singla, R Garg, “Performance analysis of Papercrete in presence of Rice husk ash and Fly ash” ICAMBC 2020 pp 1-10.
- [26] Tiziana Cardinale, Michele D’Amato, Roselena Sulla and Nicola Cardinale “Mechanical and Physical Characterization of Papercrete as New Eco-Friendly Construction Material” MDPI 2021 pp 1-11.