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Review of the mechanical properties of concrete by adding clay brick residues as a partial substitute for coarse sand

Revisión de las propiedades mecánicas del concreto adicionando residuos de ladrillo de arcilla como sustituto parcial de la arena gruesa

S.P. Muñoz Pérez [1]* http://orcid.org/0000-0003-3182-8735
A. Serrato Mio* http://orcid.org/0000-0002-3503-3887
B. Burga Delgado* http://orcid.org/0000-0002-2385-8822

* Universidad Señor de Sipan, PERU

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Abstract

http://orcid.org/0000-0002-2385-8822The present research aimed to make a systematic literature review on the mechanical properties of concrete by adding CCB as a partial substitute for coarse sand, whose methodology was to review 80 papers indexed in database such as Scopus, Ebsco Host, Scielo comprised between the years 2017 to 2021. As results were found that the mechanical properties of concrete improve by adding brick waste, process in which the CCB are crushed with the Angels abrasion machine, the sand samples were partially replaced in 15%, 20% and 25% of the CCB as partial substitute of the sand the results of this addition showed that when the addition is respected a good compressive strength is obtained, but when it exceeds 30% would cause a low density due to high absorption of the CCB. It is concluded that the replacement of CCB by sand can be used in the production of concrete because it improves its mechanical properties in addition to protecting the environment.

Keywords: *Strength; concrete; brick; coarse aggregate.*

Resumen

En el mundo de la construcción, la cantidad de residuos de ladrillos de arcilla (CCB) procedentes de la demolición y la construcción está aumentando considerablemente, y dichos residuos se reutilizan para mitigar la contaminación ambiental. La presente investigación tuvo como objetivo realizar una revisión bibliográfica sistemática sobre las propiedades mecánicas del hormigón mediante la adición de BCC como sustituto parcial de la arena gruesa, cuya metodología fue revisar 80 artículos indexados en base de datos como Scopus, Ebsco Host, Scielo comprendidos entre los años 2017 a 2021. Como resultados se encontró que las propiedades mecánicas del concreto mejoran con la adición de residuos de ladrillos, proceso en el cual los BCC son triturados con la máquina de abrasión Angels, las muestras de arena fueron sustituidas parcialmente en un 15%, 20% y 25% de los BCC como sustituto parcial de la arena los resultados de esta adición mostraron que cuando se respeta la adición se obtiene una buena resistencia a la compresión, pero cuando supera el 30% provocaría una baja densidad debido a la alta absorción de los BCC. Se concluye que la sustitución de CCB por arena puede ser utilizada en la producción de hormigón porque mejora sus propiedades mecánicas además de proteger el medio ambiente.

Palabras clave: Resistencia; hormigón; ladrillo; agregado grueso.

[1] ***Corresponding author:***
Universidad Señor de Sipan
E-mail: msocrates@crece.uss.edu.pe

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1. Introduction

Being one of the great problems in developing countries the lack of housing, as well as construction materials at favorable costs, including cement and sand that make up concrete, currently the construction industry has innovated materials looking for new products and alternatives. This is confirmed worldwide, in various investigations in which the need to add some waste materials to concrete is becoming evident because they provide greater consistency, quality and durability in addition to reducing environmental pollution. (Correa et al., 2021).

They claim that urbanization is currently producing construction and demolition waste on a large scale and as a consequence consumes a large substantial amount of the earth's resources, as well as excessive environmental pollution, becoming a true environmental and social problem that must be solved with utmost urgency. (He, et al., 2021).

Faced with the problem posed, the search for an effective recycling-reuse system arises, this practice dates back to a time after the Second World War, when German engineers in their motivation for national reconstruction, as well as the elimination of rubble from the They used this debris to turn it into recycled brick aggregates, with which 175,000 German homes were built. (*Jiang et al., 2020*).

Our country, Peru, is not exempt from this great environmental problem, such is the case of Lima, it also generates a lot of construction waste that is crammed in illegal dumps or solid waste stockpiles, thus contributing to the country's environmental pollution, for which has taken some alternative solutions such as reducing concrete waste from various constructions through reuse as fine and coarse aggregate of concrete (Campos and Saenz, 2020).

The use of clay brick waste as other light aggregates to prepare concrete, constitutes a new way to take advantage of them and also allows us to save natural resources (Iqbal, 2020).

Various studies consider the benefit of using a variety of waste materials, as an alternative to aggregates to concrete. As an example we can mention: glass waste, brick waste concrete rubble, wood waste, plastic, tile, cardboard, paper and steel waste, taking |them as alternative means to reuse them in the construction industry (Olofinnade and Ogara, 2021).

The scarcity and depletion of natural resources has motivated researchers on a large global scale to focus on the possibility of reusing various materials to replace some additives in buildings with the purpose of reducing environmental impact and placing emphasis on sustainable development, in addition Replacing natural aggregates with waste materials is proven to reduce CO2 (Miah et al., 2021). According to research, the use of crushed brick as an alternative aggregate material allows the reduction of the density of concrete, the reduction of the consumption of natural aggregates and respect for the environment in which we live (*Aliabdo et al., 2014*).

The reuse of CCBs has become a great alternative or to solve the pollution problem that they cause when they are dumped outdoors, causing enormous environmental pollution. (*Resin et al., 2018*). *Concrete becomes one of the materials of greatest use and importance in construction, due to this the investigations for its evaluation and prediction about its behavior have increased notably (Cuyán et al., 2021).*

At present, in the different constructions the amount of brick waste that comes from constructions and demolitions has been increasing considerably. These residues do not receive any type of treatment, being used mainly as filling material or they are simply thrown into the ravines creating a negative visual impact. For this reason, it motivates us to investigate what to do with waste, how we can take advantage of it and how we can turn it into raw material, to be renewed and contribute to reducing environmental pollution. The clay brick waste could be crushed into tiny particles and reused in two ways, in a pozzolanic activity giving rise to a more dense mixture or also used as a substitute for sand. (Zhu and Zhu, 2020).

Many related projects have been carried out in various countries, such as the Netherlands, where 20% of coarse aggregate has been replaced by the mixture of concrete and brick waste. Likewise, in the US of the 2.7 million tons of recycled aggregate material, between 10 and 15% are used for paving, 20 to 30% in road construction among other construction and maintenance works. (Si-Ahmed et al., 2018).

Research on the mechanism of crushing brick waste into recycled powder and replacing it with cement in order to produce sustainable building materials consider this process to be a feasible method within buildings. (He, et al., 2021).

There is a real need and in order to promote the sustainability of urban development, the researchers intend to recycle construction and demolition waste through different shredding processes. Such is the case in China where the amount of construction waste that accumulates annually, increasing by 35 million tons per year, however, the availability of annual

renewable resources remains below 5%. The main residues obtained being clay bricks and mortar residues collected from brick and concrete demolitions or brick structure (Dang et al., 2020).

With the speed and progress of urban development in China, there is a considerable increase in waste from construction sites and demolition, generating 30% of mass waste from the commune of the planet as a whole, 40% of these are waste from buildings and demolition However, the amount of waste utilization and reuse of waste from buildings and demolitions are less than 5%, all this *due to insufficient regulations and mechanical technical science, causing environmental problems that are a danger to the integrity of the health of the settlers* (Zhang, et al., 2021).

Demolition contractors dispose of this waste illegally, in open landfills, to avoid transportation costs to waste treatment facilities. Egypt is one of the large countries that has thousands of landfills full of construction and demolition waste that affects the environment. (Sharkawi et al., 2018).

In order to contribute to sustainability, construction or demolition waste must be reused in the production of new cement-based materials in order to save both natural resources and solve environmental pollution problems. (Atyia et al., 2021). *Recent investigations affirm that different rates of replacement of sand by recycled concrete with different proportions of water and binder, it was found that the ceramic aggregate resulted with greater resistance properties (Dang and Zhao, 2019).*

They also state that it has been proven that the use of brick residues is a great substitute for aggregates in mortars, as they are found in large quantities in various constructions and demolitions. (Raini et al., 2020).

On the other hand, it is worth mentioning that in several investigations it has been proven that recycled brick or its residues have the capacity to absorb 18 times greater than sand, in addition, that the density of the samples experienced with this aggregate is much lower than the density of the concrete samples (Fořtová and Pavlů, 2018).

The recycling of surpluses from the demolished works has great potential, they have generated industrial secondary products for construction and the rest of bricks would be used again for the construction of pozzolanic components of cement and concrete considered highly useful for saving prices and improving concrete strength (Chen et al., 2019).

For all the above, this article aims to review the most current research on the mechanical properties of concrete by adding (CBB) to partially replace coarse sand. In addition, the results of this work will be analyzed and discussed, in order to provide new knowledge in addition to acquiring important information on the subject.

2. Materials and methods

The bibliographic review of this article began with the search for articles in the SCOPUS, EBSCO HOST, SCIELO database, in which articles referring to the mechanical properties of concrete were found, adding clay brick residues as a partial substitute for coarse sand. , then search filters (engineering, subjects, science and article) were used to select those corresponding to the period of years 2017 - 2021, after passing the filters our research was further refined, later we proceeded to select 80 articles.

The articles obtained were well studied in order to be considered and referenced in our article, of which only 80 articles were selected, the ones most referred to our subject of study that were the basis for the creation of our article. For a better selection, the following tables were organized (Table 1).

Table 1. *Articles organized by year of publication*

	YEAR OF PUBLICATION					
DATABASE	2017	2018	2019	2020	2021	TOTAL
SCOPUS		13	11	12	18	54
SCIELO		3	1	1	2	7
EBSCO		4	1	7	7	19
TOTAL		20	13	20	27	80

Own source

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The research proceeded to use key words in English: strength, concrete, brick, coarse aggregate. Articles related to the use of clay brick residues were included and asphaltconcrete studies were excluded. Only publications within the last 5 years were established, and then proceeded to compile the results in a search log (Table 2).

Table 2. Article organized keywords and filters

Own source

Database	*Keywords*	*Documents found*	*Year the search was carried out*	*Search filters*	*Documents / Filters*	*Selected documents*
scopus	*concrete with adition brick waste*	*184*	*2017-2021*	*Engineering, Materials Science*	*62*	*5*
scopus	*concrete AND brick waste*	*1211*	*2017-2021*	*Engineering, Materials Science*	*284*	*7*
scopus	*concrete AND brick waste AND contruction*	*760*	*2017-2021*	*Engineering, Materials Science*	*191*	*5*
scopus	*concrete AND brick waste AND fine aggregate*	*153*	*2017-2021*	*Engineering, Materials Science*	*47*	*3*
scopus	*brick waste in concrete*	*1172*	*2017-2021*	*Engineering, Materials Science*	*270*	*11*
scopus	*concrete with brick waste aggregate*	*527*	*2017-2021*	*Engineering, Materials Science*	*158*	*7*
Ebsco	*clay brick waste in concrete*	*20*	*2017-2021*	*Engineering, Materials Science*	*15*	*5*
Ebsco	*brick waste in concrete*	*201*	*2017-2021*	*Engineering, Materials Science*	*106*	*4*
scopus	*clay brick in concrete*	*1084*	*2017-2021*	*Engineering, Materials Science*	*241*	*7*
sky	*brick waste*	*37*	*2017-2021*	*Engineering, Materials Science*	*14*	*4*
sky	*clay bricks*	*44*	*2017-2021*	*Engineering, Materials Science*	*eleven*	*3*
ebsco	*brick waste and concrete*	*361*	*2017-2021*	*Engineering, Materials Science*	*88*	*11*

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3. Results and discussions

The selected articles refer to the different investigations that are based on the incorporation of brick residues in concrete.

3.1 Brick waste

This research tells us that clay brick is one of the main components of demolition that is usually dumped in landfills, new efficient uses of recycled clay bricks offer sustainability benefits in terms of reducing landfills. (Zhang et al., 2021). In the same way, the dust of the clay bricks used in the study comes from the waste of the recycled bricks in express demolition, (Ismail et al., 2018). *Its specific gravity and the density of the waste brick dust was determined according to the ASTM D854 standards. (Rehan Arif a, et al., 2021).*

The efficient use of construction and demolition waste is important in both sustainable construction and environmental protection. (Chen et al., 2021). Therefore, it refers that the abundant availability of construction demolition waste leads to a significant problem of eliminating soil and air pollution. (Reis et al., 2020). Therefore, it can help reduce waste storage and environmental pollution problems, while conserving natural resources. (Kenai et al., 2018).

The brick residues are crushed with the Los Angeles abrasion machine, the sand samples will be partially replaced with a percentage of 15%, 20% and 25% of brick residues. (Mobili et al.,2018). The brick residues can be crushed manually, to later go through a sieving test (granulometry) to finally be classified and obtain the coarse aggregate, fine aggregate and brick residue dust. (Ahmed et al., 2020). Also, brick residues can be given in 2 ways as brick dust or as a fine aggregate, brick dust can result in a tighter mix and can also be used as a partial replacement for sand. (Liu et al., 2020). Concrete with brick residue shrinks greater resistance to penetration and freezing also mentioned that 10% brick residue dust can reduce concrete shrinkage. (Yehualaw et al., 2021).

Brick dust can also be obtained in this way by grinding large pieces of brick and concrete that have been thrown from demolished buildings with a normal grinder for about 30 minutes until the dust is small enough. The density of the powder is measured approximately 1.21 g / cm³ (Ni, et al., 2021).

It was mentioned that the use of brick residues as a partial replacement for sand in making concrete reduces the dry density, this occurs due to the low density of brick residues in relation to fine aggregate. (Migunthanna et al., 2021). Also, the complementary water content in the clay brick residues causes an important factor in the density of the red blood cells, it can be said that there is a reduction in density with the higher water content. (Duan et al., 2020). The decrease in the density of concrete is an important factor in the addition of brick residues, in addition to improving the environment, thus the hardened density of concrete with clay brick residues as partial aggregate of the sand was determined. (Taherkhani and Bayat, 2020).

In such a situation, mine dust can be an economical alternative to sand. Research should be conducted on sand replacement for the concrete industry considering availability, cost and environmental impact (Hamid et al., 2018).

The amount of moisture in the process of the tests carried out may vary the resulting figures, on the other hand, the tests carried out on thermal and mechanical conductivity were proceeded with dry samples in a laboratory oven for a better and detailed analysis, he mentions. (Xiong et al., 2019). Their analysis mentions that the larger the size of the clay brick residues, the intensity of the cement is reduced so that both are permanent. (Li et al., 2019). *Another case would be for the manufacture of brick blocks where the decrease in density was 6.3% and 12.3% replaced by 10% and 20%, respectively. (Abeer et al., 2020).*

The procedure of brick residues that partially replaces the fine aggregate were made the necessary tests that, consisting of 60 cylindrical test tubes all of the same size and shape, were then divided into groups of 5, it was defined according to the size of the residues brick, the groups consisted of 12 specimens 3 unconfined and 9 confined. (Liang, et al., 2019). Also in these tests the properties of the clay brick residue concrete, the compression, bending, traction test was carried out and the density of the brick residue concrete was also observed, and the differences with a natural concrete were also made. (Panuwat et al., 2018). Therefore the pozzolanic reactivity of brick waste with other pozzolans is very similar to that of fly ash and slag, brick waste powders classify as medium strength therefore good for concrete. (Janotka et al., 2021).

The content of brick waste dust replacing fine aggregate that the percentage of Flow reached 4% to 5%, but when more than normal brick waste dust was added the percentage of Flow was significantly reduced between 13 % and 36% this difference could be due to the high absorption of brick waste, the reason for the difference is because at high substitution percentages of the brick waste aggregate, the absorption of these concrete from fresh brick waste is more its reduction is considerable, if the percentage of substitution of sand increases, the reduction would be less (Nasr et al., 2020). On the other hand, a very high proportion of brick residues as substitution of sand would cause an adverse effect on the mechanical behavior of the concrete. (Chakravarthi and Shankar, 2021). (Table 3).

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Table 3. *Utilization of waste brick aggregates*

REFERENCE	*AGGREGATE*	*OBSERVATIONS*	*RECOMMENDATIONS*
(Mobili et al., 2018)	*sand replacement*	*High resistance to compression*	*15% 20% 25%*
(Yang et al., 2020)	*sand replacement*	*high compressive strength low dry density*	*not exceed 30%*
(Adazabra et al., 2018)	*brick dust*	*finest denser mix*	*% optimal*
(Yehualaw et al., 2021)	*brick dust*	*reduces concrete shrinkage*	*10%*
(Nasr et al., 2020)	*brick dust*	*reduces volume percentage addiction more than it should*	*Four. Five% 13% - 36%*
(Chakravarthi & Shankar, 2021))	*sand replacement*	*adverse behavior in concrete*	*do not exceed sand replacement*

Own source

3.2 Basic physical properties

The various physical properties of construction materials are: resistance, density, plasticity, brittleness, among others, the same that determine the behavior of the materials to be used. (Lam et al., 2021). Various studies maintain that the density apparently decreases with the considered proportion of brick dust in the mixture, resulting in an increase in porosity. (Vejmelkov, et al., 2019).

It has been shown that the use of recycled bricks or discarded clay bricks, as additives to coarse and fine aggregates, have become a material with great potential for application in buildings. (Zhao et al., 2018).

Likewise, research has been carried out on the combination of different recyclable materials such as concrete and ceramics, the demolition of concrete beams and red ceramic generate very good quality materials that have given good results in different constructions (Grabois et al., 2018).

According to reference research, before mixing, clay bricks must be in a saturated dry surface condition, moistened 24 hours in advance and then dried on the surface, as well as aggregates soaked in water for better absorption and finally mix with fine aggregates (Kumar and Chandramauli, 2018).

3.3 Mechanical properties

Mechanical properties such as elasticity, ductility, hardness, among others, indicate the capacity of a certain shape related to an effort that deformed it. (Abdulnafaa., 2021). In the last decades, the granulometries of recyclable clay bricks considered as materials are a good alternative, which were prepared through classification, screening and crushing as recycled coarse aggregate, fine aggregate and complementary cementitious material. (Djafri, 2018).

The method of replacing the paste with waste materials or materials extracted from rubble, is an excellent way to reuse these materials, thus producing ecological material, obtaining the following advantages: greater reduction in the use of cement and carbon footprint, greater reuse waste, obtaining materials with greater resistance. In addition, there are no drawbacks in the case of substituting materials in the paste, as it retains its strength and remains unchanged. (Pham , et al., 2021).

Clay ceramic masses, especially red bricks, are considered raw materials with great potential to replace Portland cement in powder form, thus contributing to improve the industrial ceramic product. (Schackow et al., 2020). However, (Gyurkó et al., 2019) He was also able to observe the properties of concrete with coarse aggregates of brick residues.

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The results obtained from various research works indicate that it is possible to replace conventional aggregates with other recycled ones (aggregates or discarded bricks), however, being used in public paving, it will be restricted to a short period of duration. (de Souza et al., 2018).

Waste materials are very effective as additives in the manufacture of building bricks. Taking into account that the absorption of water is of great importance to achieve a better plasticity of the same, because the open pores in their manufacture absorb a greater amount of liquid and are more favorable for environmental care (Dawood and Al-heally, 2021). When the concrete made with brick residues was studied at 28 days, it could reach a resistance of 36 MPA, but it would not have the same luck for its density since this amount would not exceed 2200 kg / m3. According to. (Liu et al., 2021).

The maximum compressive strength achieved by concrete made with brick residues can reach 40 MPA. After 28 days this begins to decrease due to the low resistance of the aggregates of brick waste. (Wu et al., 2018). However, in his studies he assured that when bricks were manufactured with said recycled waste concrete, these concrete bricks had good resistance after 3 days. (Rodrigues et al., 2021).

The brick residues used in recycled concrete are one of our main concerns because this concrete will be used in the structural field. (Wong et al., 2018). Following the research, the best way to reuse brick waste is powder as paste, to make an ecological concrete. (Hasane et al., 2021). However, when more than 30% dust from brick waste is used there is an optimal reduction in strength. (Yang et al., 2020).

The mechanical performance test verifies that adding a small amount of recycled powder can fill the micro pores and provide pozzolan activity, thus improving the strength and hardness of cement-based compounds. (Gencel et al., 2020). In addition, the effect of the fineness of the recycled brick dust on the cement paste, and shows that the finer the powder, the denser the paste. (Adazabra et al., 2018). With this same idea, it is ensured that, with the increase in the amount of recycled powder to replace cement, the content of recovered powder is higher than necessary. Therefore, the adverse effects of high water demand from reclaimed dust and more unreacted brick dust play a vital role, and the mechanical properties will be reduced. (Noaman et al., 2021).

The durability of lightweight concrete with such high porosity poses one of the greatest challenges in concrete mix design (Rashed et al., 2021). In general, lightweight concrete has poor durability which can facilitate the penetration of water and contaminants into the concrete, resulting in a deterioration of the mechanical properties of the concrete. It can result in corrosion of the rebar. Therefore, the properties related to durability must be carefully studied to increase the service life of concrete. (Pasupathy et al., 2021).

On the other hand, the addition of carbon magnetic nanotubes in concrete also improves the physical and chemical properties; therefore, when it is exposed to a room temperature of 800 ° C, its resistance is very pleasant. (Barboza, Monja, & Pérez, 2021).

Table 4. *Utilization of brick waste*

REFERENCE	***REPLACEMENT***	***REMARKS AND ADVANTAGES***
(Zhao et al., 2018)	*As fine aggregate or coarse aggregate*	*great potential in buildings*
(Grabois et al., 2018)	*recycled aggregate demolition materials*	*good quality concrete*
(Dawood & al-heally, 2021)	*as addictive*	*brick making*
(Liu et al, 2021)	*concrete with residues at 28 days density*	*compressive strength of 36 mpa lower density 2200 kg / cm3*
(Wu et al., 2018)	*maximum resistance to 28 days of concrete with residues*	*40 mpa*

Own source

4. Water absorption

For water absorption, the water absorption rate can be used to evaluate the water permeability of concrete, and the final water absorption capacity gives an indication of the pore structure of the concrete. If the water is quickly absorbed, the water permeability is significant, when the final water absorption is high, the pore volume is also significant. (Zhang et al., 2020).

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The presence of water plays an extremely important role in the durability of cementitious materials and, therefore, the absorption of water is considered an essential property, and that also the absorption of water is a more suitable parameter to evaluate the quality of materials. of concrete. (Huang, et al., 2021).

CCB aggregates require more water than natural aggregates, so it is advisable to pre-impregnate this aggregate or increase the water to mix. Thus, it confirms the effectiveness of plasticizers in reducing water absorption, so it can be adapted to this study. (Sukmak et al., 2021).

The influence of additional water on the initial water absorption capacity of concrete can be understood for concrete mixes, more additional water constantly led to an increase in the initial water absorption. The effect of higher additional water content results in higher porosity in the cement mix that is similarly reflected in water absorption. (*Boucherit et al.*, 2020).

One of the highest attributes of CCB, is where the part of the water added in the mix for the hydration of the cement will comply with the submersible pores which will result in the reduction of the workability of the concrete. This inconvenience can be compensated by a pre-soaking process of the aggregates, so it must be taken into account during the concrete mixing process. (Bassani and Tefa, 2018).

The absorption properties reflect the volume and connectivity of the pores in cementitious matrices. Various fineness and replacement ratios of CCB lead to different water absorption properties of the cement-bonded compounds. (Rovnaník et al., 2018). Furthermore, the addition of an appropriate fineness and replacement ratio of CCB could decrease the water absorption of the recycled mortar (RBP), and the decrease in water absorption is significant with an increase in the fineness of RBP. However, if the amount of low-fine CCB becomes too large, the water absorption of the recycled mortar also increases. (Tang et al., 2020).

On the other hand, when a mortar was made in the masonry with residues or brick dust to replace the sand, it could be seen that the mortar was considered dry due to its consistency index, which is below 250 mm, to that it is a plastic mortar should be between 260 and 300 mm, when it exceeds these ranges it is considered a fluid mortar. (Azevedo et al., 2019). After testing with brick residue concrete, it is during the first 10 minutes that the greatest water absorption can be seen. (Nepomuceno et al., 2018).

The water absorption of the concrete building elements increases with the decrease of the cement content and the increase of the total content of the crushed clay bricks. Replacing coarse and fine aggregate with recycled aggregate increases the unit of concrete masonry dry mass by approximately five times. This may be due to the highly porous nature of the crushed brick aggregate. (Zhu et al., 2019).

The studies carried out by the different researchers including one of them, (Suárez et al., 2017). He questions that the main thing is to find a good resistance because it is the predominant factor in the structural field and the brick residues in that aspect are weaker and more porous compared to a normal aggregate. Therefore, when the size of the brick waste particles was changed, the compressive strength varied, this implied that when the particle size was smaller, the strength increased. (Chakradhara Rao, 2020).

4 Conclusions

– *This article tried to give the best reuse of all the properties that clay brick residues may have as a substitute for sand in concrete, it has been proven that replacing fine aggregate with CCB is viable and this would help us to use it. of natural aggregates.*

– *It was found that the density of recycled concrete is reduced when the percentage of substitution of CCB was increased. The partial replacement of sand by CCB and the volume of excess water are determining factors in the compressive strength*

– *Brick residues can be used as a determining raw material in the elaboration of recycled concrete, it was observed that concrete with CCB has a better resistance to compression, but it was also observed that while their resistance is greater, the dry density decreases considerably .*

– *With the reuse of brick residues in concrete it also helped us to reduce the corrosion of the steel reinforcement by 18%, with this study we would also help to clean the environment since environmental pollution is reduced with the reuse of these residues brick.*

– *It was found that concretes containing brick residues have better ductility. Compared to natural concretes.*

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