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INFLUENCE OF USING DIFFERENT TYPES OF FIBERS ON THE MECHANICAL PROPERTIES OF ROLLER COMPACTED CONCRETE A REVIEW

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ABSTRACT

There is an important and urgent need to construct more durable pavements, Roller Compacted Concrete (RCC) is a strong and durable product that is commonly used to construct pavements because of its various benefits, including quick paving, labor savings, a decrease in quantity of Portland cement contains, and the use of cementitious substances in place of cement. Also, RCC has disadvantages which are its rigidity, cracking due to thermal or plastic shrinkage, flexural strength, fatigue loading, and lower tensile strength. So, using different types of fiber in the construction of RCC is necessary to control these disadvantages. This paper reviews the consequences of the various types of fibers used by researchers and which types are more advantageous, have a good option to be used, and be a guide to clarify the significance of the fibers in the construction of RCC pavements. Most of them have higher durability and cost-effectiveness while some of them have environmental issues.

KEYWORDS: Fiber addition, flexural strength, RCC pavements, tensile strength, Vebe time.

1- INTRODUCTION

Road pavements commonly are classified into two types: flexible (asphaltic materials) and rigid (reinforced concrete). Both must be placed on solid soil foundations. Asphaltic pavement is a quick and inexpensive technique; however, it is not as durable as concrete pavement [1]. Concrete pavements maintenance and durations of renovation are very long compared to other pavements; especially roller compacted concrete pavements (RCCP), [2]. Because of its sustainability and durability, Concrete pavement is cost-effective and beneficial. Roller-compacted concrete (RCC) is defined in Cement and Concrete Terminology (ACI 1 16R-99) as "concrete compacted by roller compaction; concrete that, in its unhardened state, will bear a roller while being compacted" [3]. Roller compacted concrete is a zero slump product that is made from the same ingredients as conventional concrete. [4, 5]. According to historical research, the first RCC pavement in Canada was constructed in 1976 to carry heavy loads from Oregon sorting yards. The pavement was cement treated base with an asphalt overlay. [6]. Roller Compacted Concrete (RCC) was a kind of concrete that was developed around the time of 1980[1]. There are several techniques for designing RCC, such as the corps of engineers' practice, the roller compacted dam method, the high paste method, and the maximum density method [7]. RCC is made of the same ingredients as conventional concrete, including cementitious materials, well-graded aggregates, and water, but it has a different mixing proportion. The primary difference between RCC mixtures and conventional concrete mixtures is that RCC has a higher percentage of fine aggregates, providing consolidation and tight packing. [8]. Figure 1 shows typical comparisons of materials between conventional concrete and RCC. RCC contains less cementitious material than conventional concrete, with more percentages of fine aggregates.

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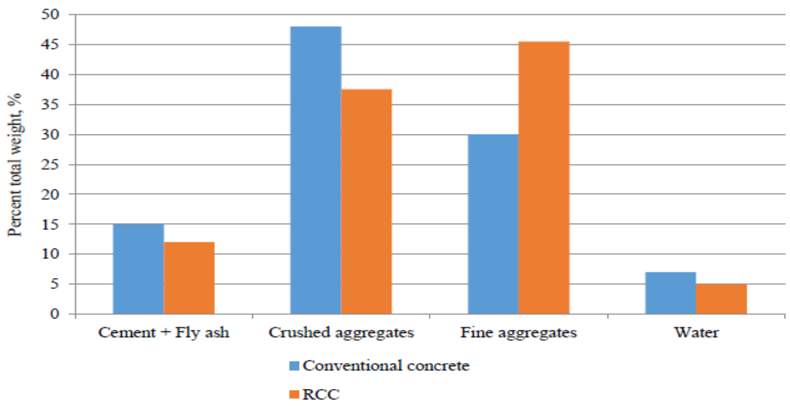

Fig. (1): Typical material comparisons of conventional concrete and RCC (Audrius V. et al)

Roller Compacted Concrete (RCC) is a durable product that is widely employed in the construction of roadways and pavements, and it can be categorized based on its numerous advantages such as fast paving, labor savings, less Portland cement contained, and using cementitious material as a replacement for cement. The construction method used to construct RCC for pavements is highly useful because there is less labor involved in the concreting process (no finishing or formwork is required), construction costs are reduced because no reinforcing steel or dowels are required and there is fewer paste in the concrete matrix due to the low water-to-cement ratio, there is no bleed water and less shrinkage than with conventional PCC [9]. Because of the great significance of aggregate in concrete, load transfer across control joints and cracks is achieved through aggregate interlock, which is required for the elimination of load transfer devices. [10], and the potential disadvantages and problems include the possibility that RCC's profile and smoothness are unsuitable for high-speed traffic pavements without diamond abrasion, and the amount of RCC that can be mixed in a transit mixer or ready-mix truck is typically lower than for conventional concrete due to the dryness of the RCC mix [9]. According to Petr Bílý et al. [11], there is a strong relationship between mechanical properties and overall costs during the phases of construction, service, and maintenance, the Figure 2 shows the properties and potential benefits of roller compacted concrete for concrete pavement.

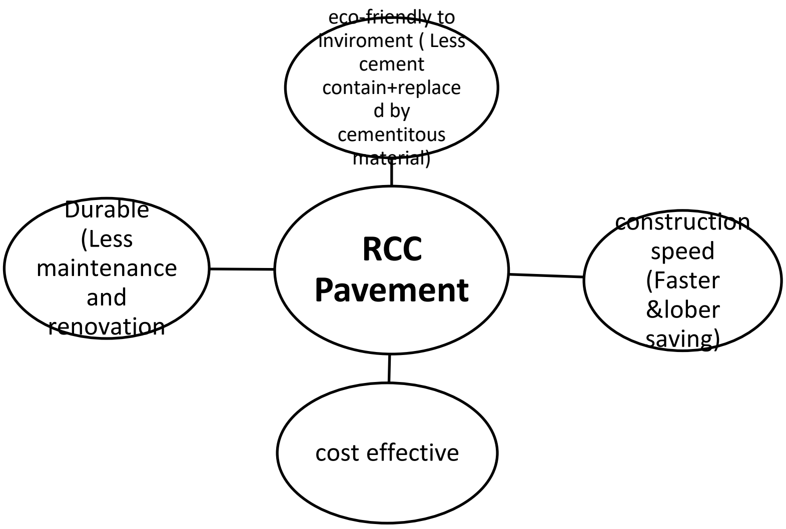

Fig. (2): Characteristics and benefits of roller compacted concrete for concrete pavement.

Additionally, RCC exhibits high rigidity and low tensile strength, which results in a tendency for cracking under flexural and fatigue loads as well as thermal or plastic shrinkage. [12]. Different types of fibers such as (steel fibers, macro-fibers, basalt fibers, synthetic fibers, crimped steel fibers, scraps fibers, and many types of polypropylene-based fibers) concerned the load transfer, controlling the cracks and improving the surface texture during rutting, are used. This paper is a review of research papers on using fibers in the RCC. The figure 3.showed the different types of fibers used in RCC.

Fig. (3): Different types of fibers are used in roller compacted concrete pavement

RCC does not permit the usual placement of dowel bars due to its construction method. Thus, it may be difficult to transfer loads through contraction joints in an RCC pavement, especially at higher traffic intensities. This produced more cracking and, as a result, increased maintenance costs, thus fibers were added. Neocleous K, Pilakoutas K [14] showed that steel fiber reinforced roller-compacted concrete pavements can consume up to 40% less energy than commonly used asphalt pavements and cost up to 12% less. So, using fibers in roller compacted concrete have more important, in the table 1 shows the cost of different types of fibers in two of a country where manufactured fibers are more.

Table (1): cost of different types of fibers

Fiber type	Tensile strength (MPA)	Length (mm)	Cost in china (US dollar) [41,42,43,44,45]	Cost in Iran (US dollar) [46]
steel fibers (Glued, hooked, straight, flat, crimped)	1100,1700,200	35,50,60	$810-870 / Ton	$1400/ Ton
Polypropylene fiber, Monofilament, fibrillated	345-560	6-10-12-15-18-20	$2700-3300 / Ton	$2200 / Ton
Fiber glass.	1700,2000	12,18	$550-1500 / Ton	$1200/ Ton
Synthetic fibers.	640,550,	48,58,	$2400-2800 / Ton	US $3700/ Ton
Basalt fiber	2425	0.1-30	$1400-2800 / Ton	-----

According to the table, glass and steel fibers were the cheapest option, but because steel fibers had the greatest effect on the mechanical properties of RCCP, using steel fibers was the best option among all fibers. While the use of plastic waste fibers (1%) led to improvement in the properties of each of the compressive strength and flexural strength compared with reference concrete [30]. This review followed an introduction of the RCC and it is advantages, and clarify the effect of using different type's fibers on fresh properties, and mechanical properties (compressive strength, flexural strength, tensile strength) of roller compacted concrete. The purpose of this review study is to investigate the effect of different fiber additions on the fresh, and mechanical properties of RCCs, including VeBe time, compressive strength, flexural strength, and tensile strength, Furthermore, a significant portion of this paper is devoted to developing a technique for producing

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concrete pavement with fiber-contained. This is the first review paper on this topic and contains an analysis of the results obtained by researchers in recent years. This study aims to produce the high-performance and more durable concrete pavement by the use of fibers to construct roller compacted concrete pavements.

2. Literature Review

RCC has become a widely used application in recent years, particularly in urban areas. RCC pavement was selected as a potential solution for failing pavements in this area because it can be built more quickly than traditional concrete pavements and provides adequate structure for truck traffic [13]. There have been various studies on the material properties and structural performance of RCC. Workability (Vebe test) and mechanical properties (compressive strength, flexural strength, splitting tensile strength, modulus of elasticity, and various structural behaviors including the shear and flexural behavior of RCC beams) are the most important and frequent parameters of RCC described and addressed in research studies.in this part, we focused on these papers that use different types of fibers to improve the properties of RCC. Neocleous K, Pilakoutas K [14]. showed that steel fiber reinforced roller-compacted concrete pavements can consume up to 40% less energy than commonly used asphalt pavements and cost up to 12% less. So, using fibers in roller compacted concrete has more important, in the study by PitiSukontasukkul et all. Using the hooked steel fiber in RCCP by the addition of (1, 0.5) % (concrete volume), the laboratory test done were Vebe time, flexural strength, and compressive strength, the results showed that steel fiber increases both Vebe time values and flexural strength while compressive strength decreased by (1-2)% of additions.[1].Other studies by Sadik Alper Yildizel, using ground calcium carbonate (GCC), with basalt fiber(BF), the different dosages of (GCC) (5, 10, 15, 20%) by the replacement of cement ,and different dosages of (BF) (0.5,0.75,1,1.25)%, were used with the test of workability ,water absorption, compressive strength, and flexural strength, the result indicated that BF decreases workability, while GCC increases workability, and decrease water absorption, and samples with 20%GCC compressive strength up to27%, also the BF increase flexural strength, the optimum dosages of both BF and GCC is 1.25 % and 20 % respectively.[15].The study was done by Onur Ozturk et al. Using steel fiber and PPF with 0.5% of the weight of cement flexural and compressive strength was measured in laboratory tests compressive strength, and flexural strength, the results showed that steel fiber improve both flexural and compressive strength but (PPF) decreased both compressive and flexural strength.[16].Pourjahanshahi, and others. Various types of crimped steel fiber and synthetic fibers were used to investigate compressive and flexural strengths, flexural toughness, drying shrinkage, porosity, and water sorptivity of the RCC pavements. The results showed that increasing the fiber volume from 0.5% to 1% might reduce drying shrinkage while improving FR-RCC flexural toughness. Furthermore, the porosity and water sorptivity of the RCC mixtures were found to increase with fiber replacement. [17].Kemal Armagan et al. mixed the additive in weight ratios of (1%, 1.5%, and 2%) with two different types of scraps that had diameters of 7 mm and 5 mm. The results of the study showed an up to 11% increase in the specimens' flexural properties. Additionally, the specimens' freeze-thaw effects were investigated, and it was shown that 2% scrap usage gave the best results. [18]. Another study done by Ismail Kilic and Saadet Gokce Gok found that using two different polypropylene-based fibers (type PP and PP/PE) with a ratio of (0.2, 0.15, 0.1) % and (0. 5, 0.3, 0.1) % of both fibers, the reduction in compressive strength were (48.6% ,14.4%) with the (0.5% and 0.2%) of fiber inclusion, the addition of polypropylene fiber enhanced water absorption while decreasing specific weights in fiber reinforced roller compacted concretes. However, roller compacted concretes made of PP-fiber behaved well during the freeze-thaw attack. [19]. M. Abu-Bakr et al. [20] investigate the compressive strength, tensile strength, and durability properties of roller compacted concrete (RCC) containing metakaolin with or without steel fiber. The compressive strength of RCC containing MK, with steel fiber increases as it ages. The optimum mixtures of RCC were determined to be (45 kg/m^3 of steel fiber, and 15% MK) after 90 days, increasing the steel fiber, and MK content of the mixture also enhances the splitting tensile strength, and permeability decreases gradually as the combined steel fiber, and MK addition increases, reaching at 77.9% for a mix that with (60 kg/m^3 of steel fiber, and 20% metakaolin).Another study by Shafiepour to clarify the behaviors of RCC using macro synthetic fibers in the mixture improves some properties of the concrete, such as crack growth rate, shear transfer along joints, and flexural strength but the results of the freezing-thawing cycles indicate that the addition of macro synthetic fibers reduces the overall durability of the specimens against freezing-thawing cycles. The diameter of the fiber also has an effect on the durability properties of RCC; studies show that shorter fibers used in RCC specimens have a low durability index in freezing-thawing cycles. [21] in another studies using four macro-synthetic and two steel fibers with it is dosages (0.2% and0.4% by volume), The findings indicate that the steel fiber had no influence on RCC maximum dry density while the addition of synthetic macro-fibers increased the maximum dry density of RCC, it is above control RCC mix. In comparison to the control RCC mix, the resulting RCC with fibers displayed a statistically significant enhancement in compressive and split tensile strength for a variety of fiber types. In another studied by M. Madhkhan et all [60] glass fiber textile were used to improve the performance of RCC pavement the test results showed that increasing the matrix workability and flexural strength. The addition of fibers improved RCC's residual strength capacity, and post-peak but did not increase the flexural strength. As in ordinary Portland cement concrete, increases in residual strength were based on fiber type and geometry (PCC) [22].in some research using waste material as fiber to improve the properties of RCC such as studied by D .Scorza et all [58] was used Hybrid Fiber I RCC pavement, the result indicated that Increased fracture toughness, and in the studied by M. Mohod and K.Kadam [59] waste tire steel fiber was used to improve the properties of RCC, the findings shown that Enhances mechanical properties of concrete. So, the using different types of fiber in roller compacted concrete in more research and study were investigated, Table 1 shows the studies and effect of fiber on the properties of RCC. The papers and research on using fibers in the RCC pavement are and the aforementioned papers are the newest papers on this topic, so this paper in the section (data analysis) collected data and analysis of the results of studies using fibers in the RCC pavement to be as a guide to clarify it is significant of the fibers in the construction of RCC pavements.

Table (2): effect of different fibers attempted by the past researches

Reference	Type of NA	Addition	Property studied	The action of Fibers in concrete
Kagaya ,et all (2001) [47]	hooked and intended steel fibers	1 % (Vol %)	degree of segregation, flexural strength, flexural ductility, frost resistance	Reduced Segregation, improved Flexural strength, ductility, and frost resistance
Sobhan, K., and Mashnad, M. (2001) [51].	recycled plastic fibers	92 percent	compressive, splitting tensile, and flexural strengths	Increased compressive, splitting tensile, and flexural strengths
M. Madhkhan et all (2011). [23].	Hooked Steel 60mm and poly-propylene fiber	SF 30, 45, 60 $kg/m^3$and PPF 1 kg/m^3	Compressive strength, toughness	Increase both compressive, and toughness,
M. Madhkhan et all (2012) [52]	steel & polypropylene fibers together pozzolan	30, 45, 60, 1 kg/m3	compressive, splitting tensile, and flexural strengths	Increased compressive, splitting tensile, and flexural strengths
S. Yazici et all (2015).[24]	Polypropylene fiber	0%,0.25%, 0.50% and 0.75%	Water absorption. CS.FS,TS, fracture impacts, and toughness	Increased the water requirement. The Mechanical properties of RCC mixtures decreased by 20% fracture impacts and toughness increased.
H.Angelakopoulos et all. (2015). [25].	wire bundles in tyre 30 mm in length	0.5% ,1%, 1.5%, 2% by mass of concrete)	Absorption of water, modulus of elasticity, Ultrasonic pulse velocity	SFR-RCC with 2% and 6% fiber dosages (by mass of concrete) water demand increases, of 3% (by mass) RTSF fibers, achieving compressive strength,
P. Kolase (2016).	Triangular polyester	used as 0%,	Compressive strength, water	Decreases compressive and

[26].	fiber	0.25%, 50% , and 0.75% volume	absorption, flexural strength, splitting tensile	flexural strength, water requirement increases. Decrease tensile strength
S. Hejazi et all (2016) [54]	Steel and polypropylene fiber	0.1% to 0.4%pp, 0.4% steel fiber	thermal stress	induced thermal stress
N. Jafarifar (2016)[39]	Recycled Steel Fiber	around 2.5% by mass	Bending tests, Drying, and shrinkage tests	Due to shrinkage, the tensile strength at the top surface can reduce by around 50%, which also results in compressive stresses at the bottom of the slab (reducing tensile stresses at the bottom arising from traffic load in the interior areas of the slab, by around 30%).
R.Tanzadeh et all. (2016) [50].	basalt fibers, recycled polyethylene	3,3.5,4 kg/m3	compressive, splitting tensile, and flexural strengths	Increased compressive, splitting tensile, and flexural strengths
A.Benouadah.et all. (2017). [27].	polypropylene (PP) fibers of the monofilaments types	0, 0.5, 1, 1.5,2 and 2.5 (Kg/m3)	Density, (VEBE), compressive strength, tensile strength by bending, tensile strength by splitting, Evolution of the shrinkage, degree of absorption,	reduces the density, increases VeBe time and reduction of workability, shrinkage decreases, increases compressive and flexural strength, increases water absorption and tensile strength
P. Kolase et all (2017). [28].	triangular shaped polyester fiber 2mm	0, 0.25, 0.50, and 75% by volume	compressive strength, flexural strength	Compressive decreases with an increase TPF, flexural strength increases with an increase in TPF
S.A.Ghahari et all (2017). [2].	(Trass natural pozzolan)	20% cement weight	Vebe time, compressive and tensile strength, water penetration, Deicer salt scaling.	Trass pozzolan does not change VeBe time but by using air-entraining VeBe time decrease, compressive and tensile strength decreased, water penetration decreases, and weight loss increases.
M.Shamsaei, et all (2017) [53].	cross-linked) polyethylene	5%, 15%, 30% and 50% of aggregate	VeBe time, compressive strength, splitting tensile strength, and flexural strength	reduce unit weight and VeBe, increased splitting tensile, compressive and flexural strengths
N. Jafarifara, et all (2017). [29].	Hooked, twin cone and recycle	Hooked and twin con 2%, recycled fibers (4% and 6% by mass of concrete)	Flexural strength, compressive strength	Increase compressive and flexural strength in %2 recycled fiber , Decrease compressive and flexural strength in another dosage of fiber
A. Abed .et all (2018). [30]	waste plastic fibers (WPFs)	Percentages ranging (0.5 to 2 %)	Compressive strength, flexural strength, porosity, and absorption	Compressive strength increases, flexural strength increases, the porosity and absorption increase.
H.Rooholamini et all, (2018). [48].	macro-synthetic fibers	Fibers (0–0.5%)	Vebe time, compressive and flexural strength	reduces Vebe time, not effect on compressive strength, increase flexural strength

S. Moradi et all (2018). [31].	Used Kortta Emboss Fiber	4.5 kg/m3	Vebe, Compressive strength, permeability, water absorption, sulphate resistance,	Decrease VeBe, decrease CS, increase permeability, increase water absorption, decrease sulphate resistance
S.Yıldızel et all. (2018). [32].	waste glass fiber,	1 %, 1.5 %, and 2 % volume percentage	Compressive and flexural strength, freeze and thaw resistance, Modulus of elasticity, abrasion resistance	Water content results increased, compressive strength value is decreased by 16 %, flexural strength values are changed by ± 7, decreases weight loss up to 5 %.
K.Armagan et all (2019). [18]	scraps with diameters of 5 mm and 7 mm	With 1%, 1.5%, and 2% ratios by weight.	Vebe, Compressive strength, F&T resistance	Increasing VeBe, increase CS, FS, and Scrap addition slightly improved the F&T resistance of the RCC mixes.
M.Hashemi et al. (2019). [33].	low fines content sand , cement	100% low fines sand And low fines sand +%6 limestone powder	Vebe time, compressive strength, tensile strength, Flexural strength, water absorption, ultrasonic pulse velocity, density	Vebe time decrease by adding cement but increase by using LFS and LPS, Density decreases with LFS and LPS, compressive strength is reduced, splitting and flexural tensile strength is reduced, water absorption increases, porosity decreased
PitiSukontasukkul et all. (2019)[1]	hooked steel fiber	1,0.5% (concrete volume)	Vebe time, flexural strength, compressive strength	Steel fiber showed increased VeBe, and increase flexural strength, but decrease %1-2 of compressive strength.
Z.Marcalikovet all. (2020). [34]	straight and short fibers with double hooked ends,	Dosage of 40, 75, and 110 kg/m3.	compressive strength, and flexural strength, splitting tensile	Both increase CS in 75 kg/m3 Increase flexural and tensile 40 kg/m3
Z .Algin et all (2020)[40]	Macro-Synthetic (MS) fiber	0%, 0.2%, 0.4% and 0.6% fiber ratios by volume	Freeze–thaw, dynamic modulus of elasticity, skid resistance, flexural and compressive strength	(MS) fiber is clearly in favor of the freeze–thaw resistance, The depth of water penetration under pressure data shows an increase in terms of the amount of MS fiber used, as well as a decrease in sorptivity results.
M. Haghnejad et all(2021) [57]	recycled polypropylene fiber	0, 1, 3 and 5 kg/m3	freezing and thawing	increased durability
E.Sheikh et al. (2022). [35].	fine copper slag (CS) aggregates	0–60% fine copper slag aggregates	Compressive strength, tensile strength, flexural strength water penetration.	Compressive, tensile, and flexural strength were increased. Water absorption and permeability are reduced.
O. Ozturk et al. (2022). [16]	Use Steel fiber and PPF	0.5% of the weight	compressive strength, and flexural strength	SF increases CS and FS but PPF decrease CS and FS
S.Yildizel (2022). [36].	Ground calcium carbonate, basalt fiber	5,10,15,20% (GCC cement replacement), add 0.5,0.75,1,1.25 BF	Workability, water absorption, compressive and flexural strength	BF decrease workability, GCC increases workability, GCC decreases water absorption, sample with 20%GCC compressive strength up to27%, BF increases flexural strength

N. Liang1 et all (2022). [37].	multi-scale polypropylene fiber ((micro-PPFs (FF1 and FF2) and macro-PPF (CF))	micro-PPF 0.9 kg/m3 and macro-PPF 6 kg/m3	Vebe consistency, Compressive , Splitting &Uniaxial tensile strength, and toughness of RCC.elastic modulus	Increase VeBe, Compressive. elastic modulus, tensile strength, and toughness
O. Kessala et all (2022). [38].	Date palm fibers	0.1% , 0.5 %	Compressive strength, abrasion resistance, and ultrasonic pulse velocity. Concerning durability, freeze-thaw resistance was investigated.	0.1% of treated date palm fibers proved the properties evaluated in the hardened state, Date palm fibers improved the physical, mechanical, and durability of RCC significantly. The obtained results are promising for further reflection on a large scale to explore the issue of strengthening RCCs with bio-fibers.
Jahanbakhsh, P. et all, (2022) [49].	macro synthetic fiber	2.0, 3.0, and 4.0 kg/m3	compressive, splitting tensile, and flexural strengths	Improve compressive, splitting tensile, and flexural strengths
M. Sharbatdar, and F. Rahmati, (2022) [55].	steel, Kortta Emboss, Kortta Twist, and Sinusoidal plastic	different amounts of fibers	compressive, flexural, and tensile strengths	increased compressive, splitting tensile, and flexural strengths
D.Rambabu et all (2023) [56].	polypropylene fiber	0.5–1.5% fibers	flexural and fatigue strength, durability	increased flexural and fatigue strength, durability

3. DATA ANALYSIS

3.1. Workability of RCC contain different type's fibers.

The VeBe test, which is suitable for evaluating the RCC's workability in mixture designs and specimens. The value of the VeBe time test, as determined by the results of published research, is depicted in Figure 1.from the graph the percentages of Vebe time for different types of fibers, the obtained results indicate that fibers have the impact on the workability of the RCC in pavements, addition of different types of fibers, workability decreases as reported in studies by researchers.so maximum percentage of Vebe time recorded by using (0.1% percentage of hooked end steel fibers, and triangular polypropylene 0.75%) which are (71%,and 148%) for both respectively. And minimum percentage of changes was recorded with (Micro-PPF (FF1) 0.9%, and basalt fibers 0.5% which are both 4%., and the non-impact of fibers was recorded with the high amount of (PF mm, at dosages 0f 4%) by percentages of changes obtained from different types of fibers, the results indicated that types and dimensions with the shape of fibers have an impact on the Vebe time of the fresh properties of RCC.

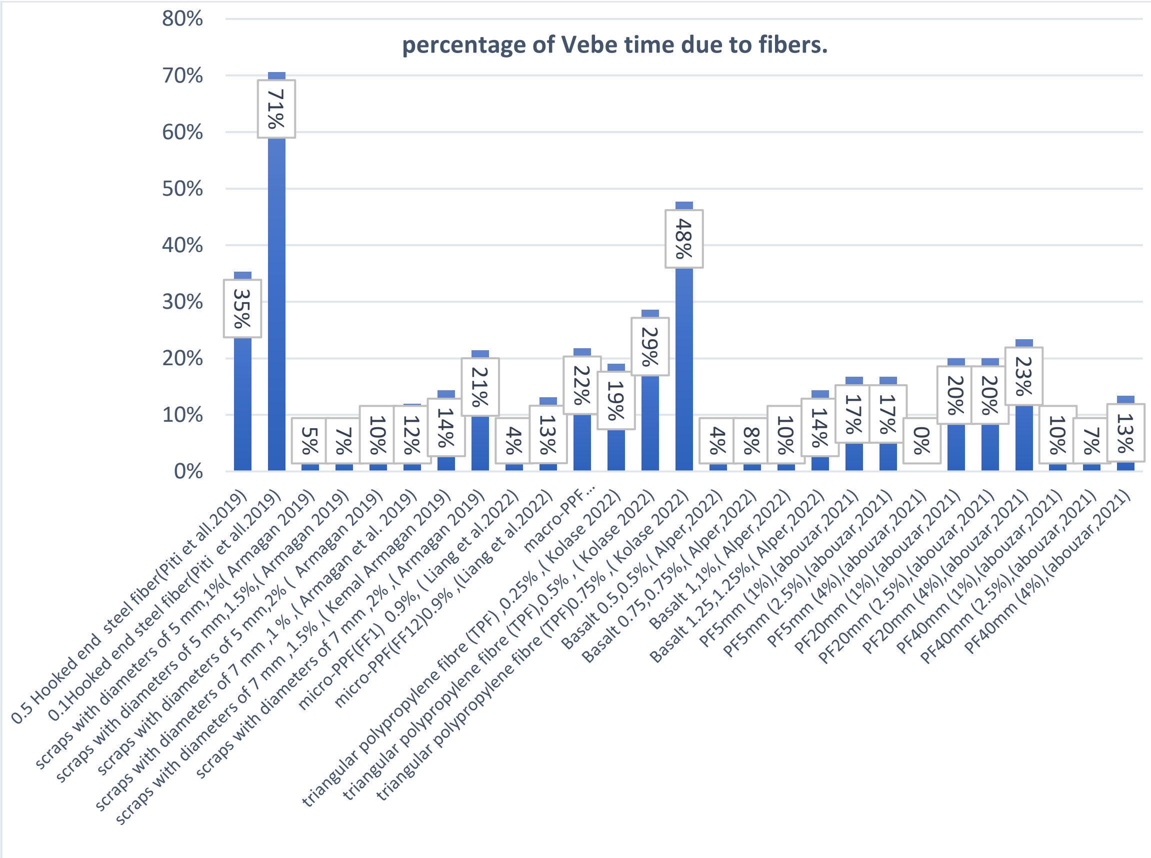

Fig. (3): Percentages of Vebe value due to different types of fibers.

3.2. Compressive strength of RCC contain different type's fibers

Compressive strength is the fundamental qualitative measure of concrete's mechanical properties, and it is commonly used by design standards and regulations to determine if a concrete mixture is suitable for a certain application. RCC has a compressive strength comparable to that of conventional concrete, so using different types of fibers has the impact on the compressive strength of the RCC, Figure 4 shows the effects of various types of fiber on compressive strength. According to the results, the compressive strength of the fiber could be classified to two types; one of them which are all fibers without polypropylenes fiber with a certain number of fibers the compressive strength increased, small amounts of fiber inclusion were required to improve compressive strength properties, and another one which are fibers with more amount addition and polypropylenes fibers decreases the compressive strength. Typically, these decreased compressive due to less adhesion of fibers to the cement mortar in the RCC mix, effects of fibers on the compaction process of RCC construction, and also Low w/cm will provide a dry mix that cannot be fully compacted. This makes the hardened mixture more porosity and lowers its compressive strength, and from Figure 4. Obtained maximum percentages of compressive strength with steel fibers with0.1% which is 36% and the maximum reduction in compressive strength were obtained from polypropylene PPF, (MM0.5%) which is 47%.

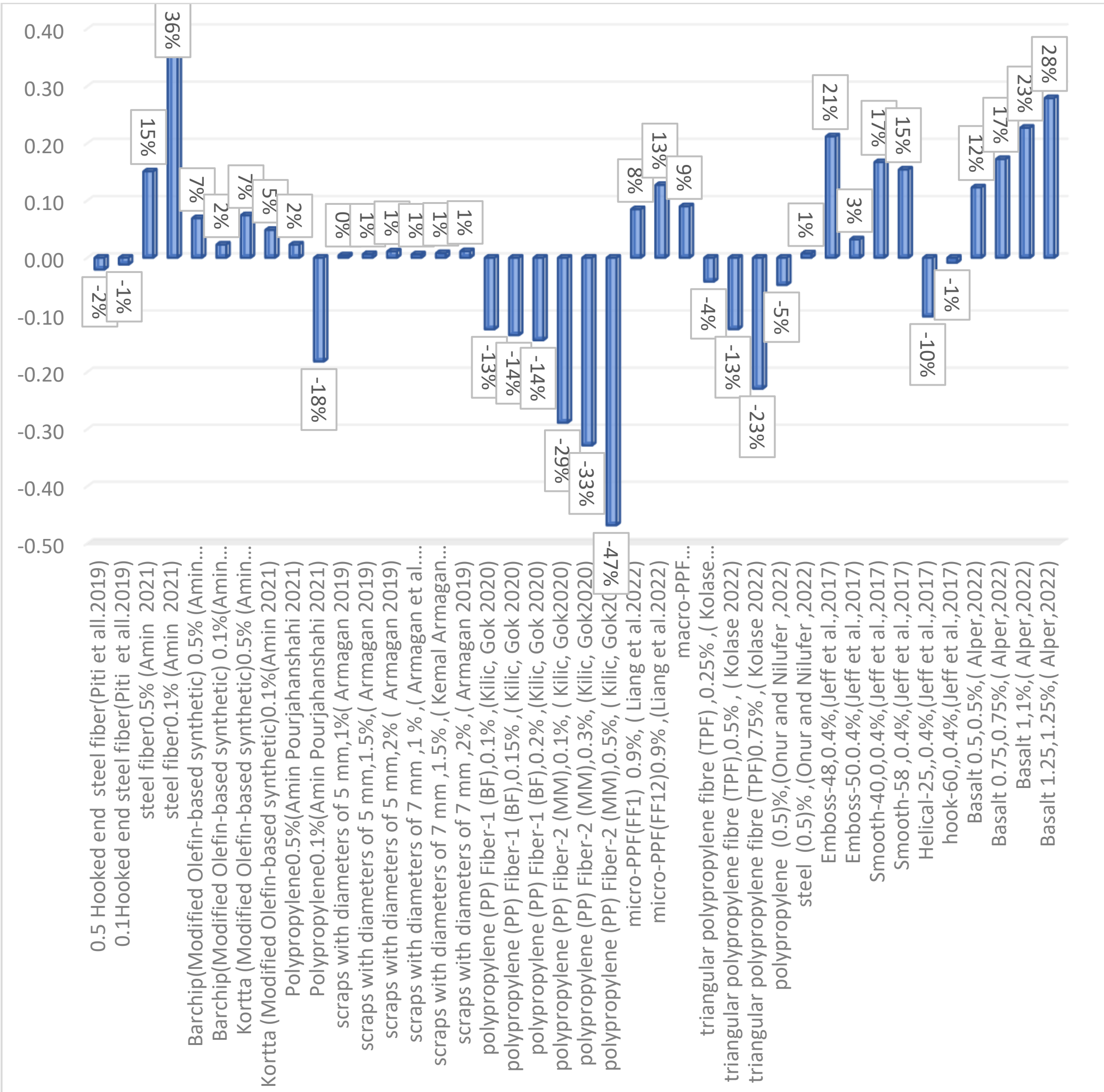

Fig. (4): Percentages of compressive strength due to different types of fibers.

3.3. Flexural strength of RCC contain different type's fibers

One of the most important factors when constructing a concrete pavement, whether it be conventional or RCC, is flexural strength. Concrete's flexural strength impacts the fatigue criteria, which governs cracking in a slab subjected to repeated loads caused on by heavy traffic. Figure 5 shows the effects of various types of fibers on flexural strength, the results showed that fibers classified in two types one of them is (steel, scraps, and metallic properties) increases flexural strength while the compressive strength also increased with the optimum dosages according the lab tests result, so when the types of fiber such as (Polypropylene, and micro-PPF) decreased the flexural strength with the more addition of the amount in the concrete mixture, also using these types are must be on the base of laboratory test results could be done. Beside of these side effect on the using (Polypropylene, and micro-PPF) on the mechanical properties these material mostly are waste and have environmental issue. Also, from the Figure 5 maximum percentages flexural strength obtained from the using basalt fiber with the dosages (1.25%),and maximum reduction of flexural strength which is (39%) from using polypropylene PPF, (MM0.5%).

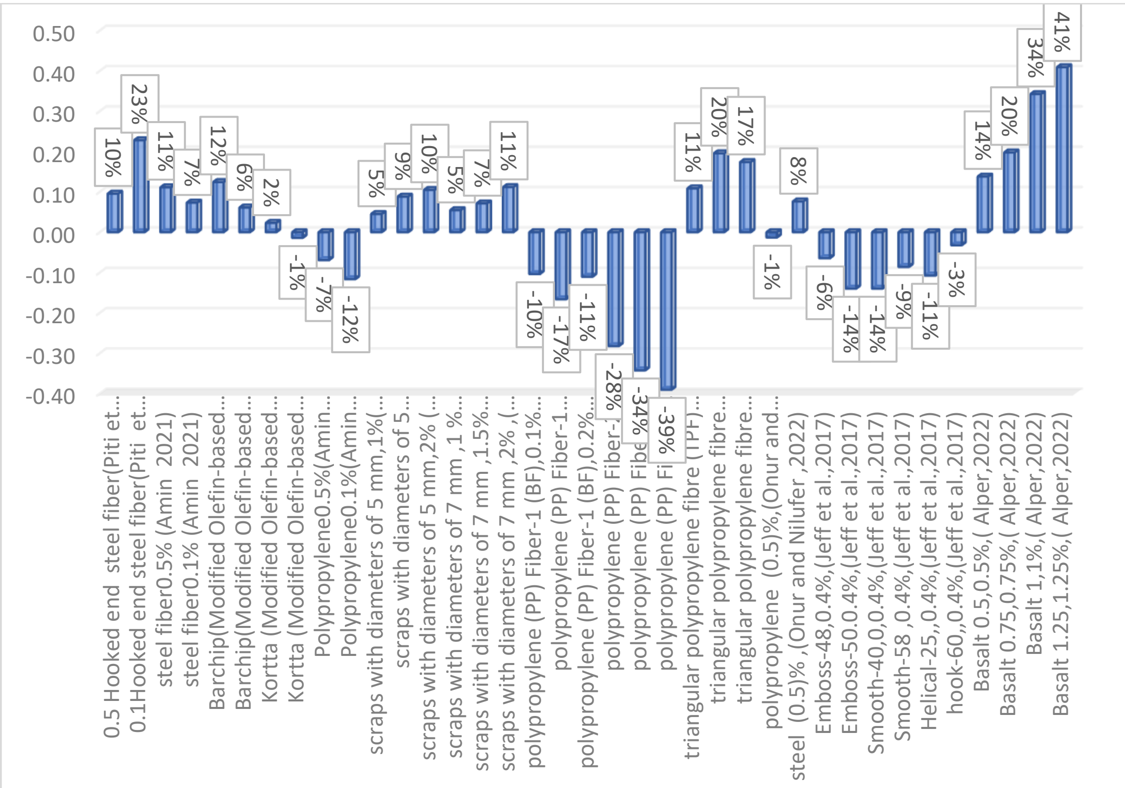

Fig. (5): Percentages of Flexural strength due to different types of fibers.

3.4. Tensile strength of RCC contain different type's fibers:

Tensile strength is a fundamental and important property of concrete. Generally, it has been proven that the addition of fibers enhances splitting tensile strength. From the figure 6. The average of increasing at 28 days is higher by (58%) than the splitting tensile strength with not contained fibers from the using the macro-fibers, hook-60, (0.4%), and generally using fibers improve the tensile strength of the RCC while the ratio of addition should be controlled, the basis for enhancing the splitting tensile strength is because fibers the work by interlocking with materials, and the fibers also may prevent cracking in samples.

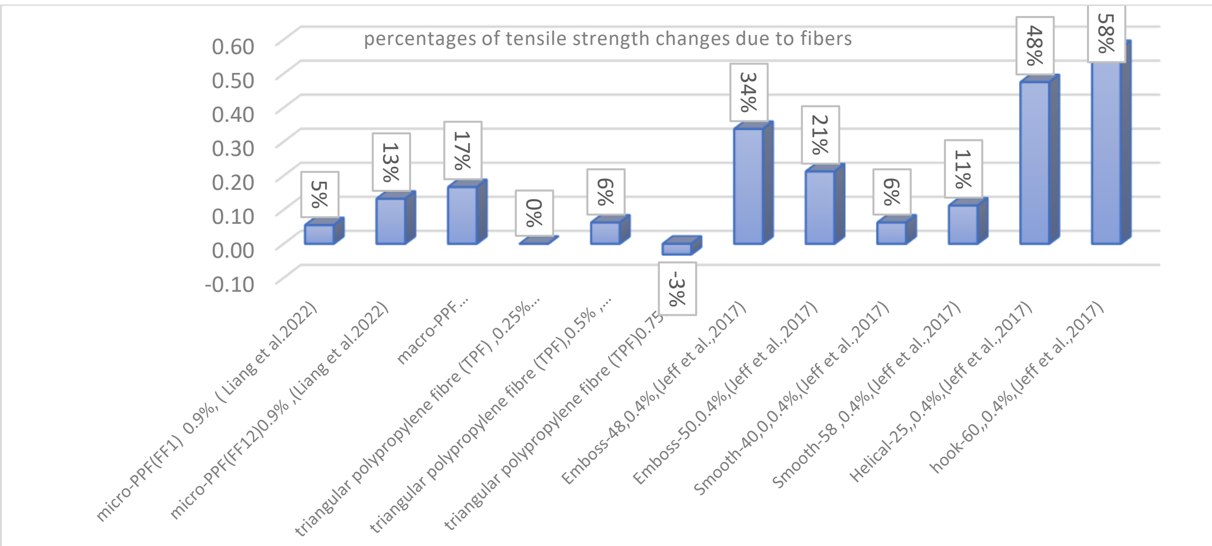

Fig. (6): Percentages of tensile strength due to different types of fibers.

4. CONCLUSIONS

Nowadays, pavement construction methods are focused toward to produce high durable, environmentally friendly, while minimizing both production costs and environmental load. RCC is a good option because of its durability, and high strength. RCC has been used for this type of application and provides a low-cost pavement with the strength to support heavy loads and the durability to resist rutting. These pavements do not soften at high temperatures or become damaged by fuel and hydraulic fluid spills. The material's production, installation, and engineering properties are well understood. The paper attempts to bring forward the importance of understanding of RCC and taking guidance from the studies used of different types of fibers in concrete pavement construction, the purpose was to increase public understanding of the advantages of using fibers in constructing RCC pavement and clarified the importance of using fibers in RCC Pavement to improve its rigidity, cracking due to thermal or plastic shrinkage, flexural strength, fatigue loading, and lower tensile strength. Steel fiber-reinforced roller-compacted concrete developed very high flexural strength when compared to conventional steel fiber-reinforced concrete. This is very beneficial to the rehabilitation of damaged concrete pavements. Also using different types of fiber in RCC have advantages and most of the fibers could be used which is an environmental issue, as a result of the data analysis, many parameters influence the improvement of the properties of RCC concrete by fibers, such as fiber diameter, length diameter ratio, the mixing amount, shapes of fibers, mechanical properties, and modification techniques. Due to differences in research techniques, curing conditions, parameter selection, and other factors.

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