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Modulus Effect of Aggregate Fineness on Compressive Strength and Flexural Test Concrete K-175

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Abstract: The research entitled the effect of Fineness Aggregate Modulus on the Strength and Flexibility Test of K-175 Quality Concrete has the aim of comparing the compressive strength of normal concrete with the composition of the aggregate grain size to form a fineness modulus (FM) value with a variation of 5.00 – 5.50 - 6.00. The method was a qualitative approach. The research was carried out in a laboratory which included Analysis of aggregates, specific gravity, and aggregate absorption, examination of aggregate content, aggregate wear testing, concrete molding, concrete treatment and final testing of the strength and flexibility of concrete. The planning of the concrete mix (concrete mix design) was determined by the number of concrete-forming materials needed. The arranged fine and coarse aggregates formed a combined fineness modulus (FM) value of 5.00-5.50-6.00. The data collection technique used was observation. The results showed that from the composition regulated by the National Standard of Indonesia T-15-1990-03, the need for fine aggregate was 101,48 kg, and coarse aggregate was 93,97 kg. By separating the grain size of the broken aggregate on a certain sieve and then distributing the grain size of the aggregate, the required fineness modulus on the aggregate is 2.93, and the fineness modulus on the coarse aggregate is 7.25, with a combined fineness modulus 0f 5.00, then the fineness modulus on the coarse aggregate. The fine aggregate is 3.40, while the coarse aggregate is 7.73, with a combined fineness modulus of 5.50. The fineness modulus of fine aggregate is 3.78, and the fineness modulus of coarse aggregate is 8.35, with a combined fineness modulus of 6.00. From the results of this study, the value of the compressive strength of concrete which was converted to cylindrical specimens at the age of 28 days was normal at 220,079 kg/cm2, while the concrete with a compressive strength value set by FM 5.00 was 160,954 kg/cm2; FM 5.50 is 206.915 kg/cm2; FM 6.00 is 267,193 kg/cm2. Meanwhile, the flexural strength of concrete is normal at 40,788 kg/cm2; FM 5.00 40,788 kg/cm2; FM 5,50 47,585 kg/cm2; FM 6.00 47,586 kg/cm2. The research concludes that the distribution is carried out by separating the grains retained on a certain sieve and composing according to the needs of the aggregate. As a comparison material, the value of the compressive strength of concrete is used in actual aggregate conditions. From the results of the compressive strength obtained that the concrete with the value of FM 5.00 and FM 5.50 decreased, but the concrete with the value of FM 6.00 experienced an increase, while the flexural strength of the concrete FM 5.00 was the same, the concrete with the value of FM 5.50 and FM 6.00 increased. The concrete with the fineness modulus (FM) value is set to have good porosity from the above conditions. It can be an option for the application of the packing density method.

Keywords: Fineness Modulus, Aggregates, Concrete, compressive strength, and Bending Strength

I. Introduction

Since the construction of civilization began, humans have been looking for a kind of cement to bind the rocks into a solid and form a mass. It is not known who tried to make concrete for the first time. However, what is clear is that both cement and concrete, like many other building materials, were not inventions that suddenly appeared, but developed gradually from various trial & error efforts over the years. Around 3000 BC, the ancient Egyptians used clay combined with straw to bind dried bricks and produced the famous pyramids of Rameses. They also used lime as a cement binder in the pyramids at Giza. Some researchers say it is lime concrete, while other authors say the adhesive is formed from limestone (gypsum, burnt lime) [1]. At the same time, adhesives bind bamboo to boats and the Great Wall in Mainland China. Around 300 BC the Romans perfected the adhesive above. They use limestone in colosseum buildings, aqueduct networks and many other types. In the second century BC, the Romans excavated materials such as pink sand from a source at Ponzzuoli, near Mount Vesuvius, Italy [2].

In 1824, mason Joseph Aspdin applied for a patent in England to manufacture the first artificial cement by burning a mixture of lime and clay in his kitchen stove and then grinding it into a fine powder. This powder is called Portland Cement. So-called, not because it is made in a certain place or has become a certain trademark name, but is a generic product because of its grey colour, and the resulting strength is similar to natural cement from Portland Island in England [3]. Since the 1990s, advances in concrete technology have led to high-performance concrete, namely concrete with high performance in certain aspects to achieve work goals optimally. One of these types of concrete is concrete which minimizes compaction during its implementation. This type of concrete is called self-compacting concrete. The concrete is obtained by adjusting the composition of the aggregate size so that it forms a predetermined fineness modulus (FM) [4]. Dacko (2021) wrote that the benefits of self-compacting concrete are faster completion of work, reduced labour, and a more attractive concrete surface [5].

In new conditions, concrete must have good workability and stability properties. Workability is the level of ease of the concrete to be worked, poured, and compacted. Setting the grain size composition in the aggregate provides convenience in the compaction process [6]. However, it is necessary to pay attention to the level of workability that must be considered. Stability is defined as the ability of the mortar to maintain all particles of the material forming the concrete forming material to be uniformly distributed. The instability of the mixture is generally in the form of bleeding and segregation. In hard conditions, concrete must have optimum strength. The strength of concrete can generally be read by observing its compressive strength. The compressive strength of the concrete used as the design measure is the compressive strength at 28 days [7].

What greatly affects the two properties of concrete above is the nature of the constituent materials. One of these properties is the aggregate fineness modulus (FM). Shetty (2019) states that fine aggregate affects the ease of work while the gradation of coarse aggregate affects the strength of concrete [8]. Furthermore, Whittmann (2000) wrote that the distribution of aggregate grain size is an important factor in achieving high fluidity without segregation. The moisture content, including water in the dough, may be contained in the aggregate condition, and excess moisture is saturated with dry surfaces. If the aggregate is dry or unsaturated, it will be deducted from the mixing of water required to fill the pores of the aggregate and increase the porosity [9].

Concrete porosity is a level that describes the density of concrete construction. This porosity is closely related to the permeability of the concrete. Concrete porosity also describes the size of the strength of concrete in supporting a construction. The denser the concrete, the greater its strength to support heavier constructions. On the other hand, the more tenuous the concrete is, its strength will be weaker so that it can only support light construction, and its durability is not too long [10].

This research was conducted in order to distribute the aggregates to form a combined fineness modulus (FM) of 5.00 – 5.50 – 6.00 and to obtain the difference in the compressive strength of normal concrete with concrete that has a fineness modulus (FM) which is set with a sample in the form of cubes and flexural strength of normal concrete with concrete that has a fineness modulus (FM) value that is set with a beam-shaped sample. In this study, researchers analyzed the testing of concrete-forming materials and then planned the concrete mix design to determine the amount of concrete-forming materials needed. Then the fine and coarse aggregate grains are arranged to form a combined fineness modulus (FM) value of 5.00-5.50-6.00.

II. Concrete Forming Ingredients

Concrete is formed by mixing rock material which is bonded with cement adhesive. The rock materials used to compose concrete are generally divided into a coarse aggregate (gravel/crushed stone) and fine aggregate (sand). Fine and coarse aggregates are mixed aggregates and are the main components of concrete. Generally, the use of aggregate in the concrete mix reaches ± 70%-75% of all concrete [11].

The value of strength and durability (durability) of concrete is a function of many factors, including the comparative value of the mixture and the quality of the stacking material, the method of making the concrete mix, and the temperature and conditions of the hardening treatment. The compressive value strength of concrete is relatively high compared to its tensile strength, which is a brittle material. The tensile strength value ranges from 9% -15% of its compressive strength. In use as a structural component of buildings, concrete is generally reinforced with steel reinforcing bars as a material that can work together and help its weaknesses, especially in parts that work to withstand tension [12]. The strength, durability and other properties of concrete depend on the properties of the base material. Concrete can have very high compressive strength but low tensile strength. Such conditions are reinforced with reinforcing steel bars to form a composite structure which is then known as reinforced concrete.

Concrete mix planning aims to determine the amount of cement, fine aggregate, mixed materials and water that must meet Compressive Strength requirements. The compressive strength achieved at the age of 28 days (determined age) must meet the desired requirements according to the planned quality characteristics of the concrete, including easy to work and place in the mould (formwork), which is determined from the volume of the paste mix, the dilution of the mortar paste, the ratio of the mixture of fine aggregate and water, the durability of the concrete after hardening which is related to its compressive strength where the greater the compressive strength, the more durable the mortar, the final settlement concrete surface as well as Economical and optimum in the use of cement. Concrete mix planning must also consider the conditions after the concrete has hardened, including water density, resistance to destructive disturbances, no shrinkage/expansion due to the influence of temperature (temperature) and uniform shape. The correct and careful procedures are needed in the entire concrete production process, which includes, Material testing (material testing), Sensors and material grouping (material sensors and grouping), Dosing and mixing (batching), Stirring (mixing), Transporting, Placing, Curing. In addition, strict supervision and control over the entire procedure and quality of implementation which is supported by optimal operational coordination [13].

After hardening, the important properties of concrete are compressive strength, permeability, and shrinkage. In addition, the properties of concrete at high temperatures are influenced to some extent by the type of carbonate, silicate, and lightweight aggregates. Carbonate aggregates include limestone and dolomite and are included in one group because these two substances undergo chemical changes at temperatures between 1300o F to 1800o F. As for some of the properties of concrete in terms of its advantages and disadvantages compared to other building materials, concrete includes materials that are high strength and have properties that are resistant to rusting/rotting by environmental conditions. When made properly, the compressive strength can be the same as natural rock. High compressive strength results when combined with reinforcing steel (which has high tensile strength), which can be said to withstand heavy loads. Concrete and steel can be said to have almost the same expansion coefficient. Concrete is wear-resistant and fire-resistant, with tolerance limits on the concrete's quality. The strength of the concrete is expressed as the maximum capacity of the concrete under load. This is a very important property because the purpose of using concrete is the ability of concrete to carry loads [14].

Portland cement is a fine powder obtained by grinding clinker (which is obtained by burning a good and even mixture of lime and materials containing silica, alumina, and iron oxide), with gypsum as an additive in sufficient quantities. This fine powder when mixed with water, after some time, can become hard and is used as a hydraulic binder[15]. If cement is mixed with water, it will form a mixture called cement paste. It will form a mortar mixture if mixed with fine aggregate (sand) and water. It will form a thick mixture if added with coarse aggregate (gravel). They are commonly known as concrete. In a concrete mixture, cement and water are the active groups, while sand and gravel are the passive groups that act as fillers [16].

The index used to measure the fineness and coarseness of aggregate grains is determined by the fine modulus of grains. In general, sand has a fine modulus of 1.5 to 3.8 and gravel between 5 to 8, while the combined fineness modulus (FM) is 5.00 – 6.00 according to SK-SNI-T-15-1990-03. The properties of concrete that need to be known in detail include ease of workability in fresh concrete, homogeneity, the strength of concrete, durability of concrete, and stability of concrete form. Strength is the most important property of concrete. However, in some cases, the properties of durability/resistance, impermeability/tightness, and volume stability are more important. The strength of concrete is a parameter that can give a general picture of the quality of the concrete itself because strength is directly related to the condition of the structure in the cement paste. The main factor related to the strength of concrete is porosity, which is the relative volume of pores or voids in cement paste. Another factor can come from the aggregate, which can contain defects and trigger cracks in the contact area between the aggregate and the cement paste [17].

In the manufacture of concrete, water is an important factor, because water can react with cement, which will become an aggregate-binding paste. Water also affects the compressive strength of concrete because excess water will cause a decrease in the strength of the concrete itself. In addition, excess water will cause the concrete to bleed, i.e. the water and the cement will move to the surface of the fresh concrete mix that has just been poured. This will lead to a lack of bond between the layers of concrete and is a weak one. Water in the concrete mixture will affect the workability of the concrete mix, the size of the shrinkage value of the concrete, and the continuity of the reaction with portland cement so that it is produced and the strength of the concrete mixture takes time and the hard treatment of the concrete mix to ensure good hardening. Water for manufacturing concrete at least meets the requirements of drinking water, namely fresh, odourless, when exhaled with air that is not cloudy and others. However, it does not mean that the water used for making concrete must meet drinking water requirements. The compressive strength test uses the ASTM C39-86 standard "Standard Test Method For Compressive Concrete Specimens"[18].

III. Methodology

The research was a qualitative approach with a descriptive method of exploratory effort in material laboratory testing. The elements of this research design were based on the focus of the problem being studied, the suitability of the object of research regarding theory, informants, instruments, data collection procedures and data analysis. The qualitative research was carried out to understand the phenomena experienced by research subjects through descriptions of words and language in a natural context and utilizing various scientific methods. The validity of the data was done by triangulation of sources. Further, qualitative research requires in-depth study, not just about what and how qualitative research is, but fully understanding so that scientific work processes can produce products that meet objective criteria [19].

Analysis of the materials used in this concrete mixture must be tested first and adjusted to the planned mixture's design data and the concrete's desired compressive strength. The types of concrete materials tested were required in connection with the design of the proportion of concrete mixtures: fine aggregate (sand), coarse aggregate (split), and cement. Mixed concrete was a combination of constituent material composites. The characteristics and properties were affecting the results of the concrete mix design intended to determine the composition or proportion of the ingredients that make up the concrete. The proportion of the mixture of the ingredients made up of the concrete is determined through a mix design. The process was finished when the mixture proportion could meet the technical and economic requirements. In determining the proportion of the mixture, several methods can be used, including the American Concrete Institute (ACI) method, the Portland Cement Association (PCA) method, Road Note number 4, British Standards or the Department of Environment (BS), the Department of Public Works (PU) with the Standard Method.

The concrete strength plan was based on the relationship between the compressive strength and the water-cement factor. The selection of the proportion of the concrete mixture must meet the requirements or conditions for concrete with a compressive strength of f'c more than 20 MPa, and the proportion of the experimental mixture must be based on weight batching (PBI, 1987, p. 17), for concrete with compressive strength. f'c up to 20 MPa, trial mix proportions may be based on volume mix (batch volume-ASTM C685). Volume measurement was based on the proportion of the mixture in weight which is converted into volume based on the unit weight of the volume (bulking) of each material (PBI, 1989, p. 17), specifically for concrete which is planned to have a strength of 10 MPa, if practical considerations and local conditions do not allow the implementation of concrete by following the mix proportion design procedure (PBI: 1989:17), a ratio of 1 PC can be used: 2 Fine Aggregate: 3 Coarse aggregates, the slump value of the concrete should not exceed 100 mm.

IV. Results and Discussion

Research data for the results of this study for 3 (three) months. The research stages start from the primary data collection and observation stage, the stages of research work, the research phase, conducting observations, testing and documentation.

In this study, three variations of the combined fineness modulus (FM) were carried out, namely 5.00 – 5.50 – 6.00. In the aggregate mix planning process, the following steps are carried out. The authors determine the percentage value by filtering fine or coarse aggregates, which does not go beyond the limits determined by SK.SNI T-15-1990-03. After that, the authors combine the weight requirements of the aggregate with the total aggregate requirements into a table. Then add up the percentage of retained values to get the combined fineness modulus (FM) according to research needs. The following is the arrangement of aggregate grains.

Table 1. Fine Aggregate Distribution Plan For Combined FM 5.00

Sieve Hole(mm)	Lagging Weight			Percentage Passed	National Standard of Indonesia T-15-1990-03
	(gram)	(per cent)	total		
38	0	0%	0%	100%	100%
19	0	0%	0%	100%	100%
9.6	0	0%	0%	100%	100%
4.8	5074	5.00%	5.00%	95%	90 - 100%

2.4	10148	10.00%	15.00%	85%	60 - 95%
1.2	20296	20.00%	35.00%	65%	30 - 70%
0.6	32981	32.50%	67.50%	33%	15 - 34%
0.3	7611	7.50%	75.00%	25%	5 – 25%
0.15	20296	20.00%	95.00%	5%	0 – 10%
Sisa	5074	5.00%	-------	-------	---------
	101480	100%	293%		

$$FM = \frac{293}{100} = 2,93$$

Table 2. Coarse Aggregate Distribution Plan For FM combined 5.00

Sieve Hole(mm)	Lagging Weight			Percentage Passed	National Standard of Indonesia T-15-1990-03
	(gram)	(per cent)	total		
38	0	0%	0%	100%	95-100%
19	28101	30%	30%	70%	30-70%
12.5	0	0%	30%	70%	-
9.6	32784.5	35%	65%	35%	10-35%
4.8	32784.5	35%	100%	0%	0-10%
2.4	0	0%	100%	0%	0%
1.2	0	0%	100%	0%	0%
0.6	0	0%	100%	0%	0%
0.3	0	0%	100%	0%	0%
0.15	0	0%	100%	0%	0%
Sisa	0	0%	-------	-------	0%
	93670	100%	725%		

$$FM = \frac{725}{100} = 7,25$$

Table 3. Aggregate Distribution Plan with combined FM 5.00

Sieve Hole(mm)	Lagging Weight			Percentage Passed
	(gram)	(per cent)	total	
38	0	0.0%	0.0%	100%
19	28101	14.40%	14.4%	86%
12.5	0	0%	14.4%	86%
9.6	32784.5	16.80%	31.2%	69%
4.8	37858.5	19.40%	50.6%	49.4%
2.4	10148	5.20%	55.8%	44.2%
1.2	20296	10.40%	66.2%	33.8%
0.6	32981	16.90%	83.1%	16.9%
0.3	7611	3.90%	87.0%	13.0%
0.15	20296	10.40%	97.4%	2.6%
Sisa	5074	2.60%	-------	-------
	195150	100%	500%	

$$FM = \frac{500}{100} = 5,00$$

From the results of the grain size distribution planning, the FM value on the fine aggregate is 2.93, and the FM coarse aggregate is 7.25, with a total FM of 5.00

Table 4. Rencana Distribusi Agregat Halus Untuk FM gabungan 5,50

Sieve Hole(mm)	Lagging Weight			Percentage Passed	National Standard of Indonesia T-15-1990-03
	(gram)	(per cent)	total		
38	0	0%	0%	100%	100%
19	0	0%	0%	100%	100%
9.6	0	0%	0%	100%	100%
4.8	5074	5.00%	5.00%	95%	90 - 100%
2.4	20296	20.00%	25.00%	75%	60 – 95%
1.2	20296	20.00%	45.00%	55%	30 – 70%
0.6	35518	35.00%	80.00%	20%	15 – 34%
0.3	10148	10.00%	90.00%	10%	5 – 25%
0.15	5074	5.00%	95.00%	5%	0 – 10%
Sisa	5074	5.00%	-------	-------	---------
	101480	100%	340%		

$$FM = \frac{340}{100} = 3{,}40$$

Table 5. Coarse Aggregate Distribution Plan For FM combined 5.50

Sieve Hole(mm)	Lagging Weight			Percentage Passed	National Standard of Indonesia T-15-1990-03
	(gram)	(per cent)	total		
38	4683.5	5.0%	5.0%	95.0%	95-100%
19	39809.75	42.5%	48%	53%	30-70%
12.5	0	0%	48%	53%	-
9.6	23417.5	25%	73%	28%	10-35%
4.8	25759.25	28%	100%	0%	0-10%
2.4	0	0%	100%	0%	0%
1.2	0	0%	100%	0%	0%
0.6	0	0%	100%	0%	0%
0.3	0	0%	100%	0%	0%
0.15	0	0%	100%	0%	0%
Sisa	0	0%	-------	-------	0%
	93670	100%	773%		

$$FM = \frac{773}{100} = 7{,}73$$

Table 6. Aggregate Distribution Plan with 5.50. combined FM

Sieve Hole(mm)	Lagging Weight			Percentage Passed
	(gram)	(per cent)	total	
38	4783.5	2.4%	2.4%	98%
19	40659.8	20.62%	23.1%	77%
12.5	0	0%	23.1%	77%
9.6	23917.5	12.13%	35.2%	65%
4.8	31383.3	15.92%	51.1%	48.9%
2.4	20296	10.29%	61.4%	38.6%
1.2	20296	10.29%	71.7%	28.3%
0.6	35518	18.02%	89.7%	10.3%
0.3	10148	5.15%	94.9%	5.1%
0.15	5074	2.57%	97.4%	2.6%
Sisa	5074	2.57%	-------	-------
	197150	100%	550%	

$$FM = \frac{550}{100} = 5{,}50$$

From the results of the grain size distribution planning, the FM value for the fine aggregate is 3.40, and the FM coarse aggregate is 7.73, with a total FM of 5.50.

Table 7. Fine Aggregate Distribution Plan For Combined FM 6.00

Sieve Hole(mm)	Lagging Weight			Percentage Passed	National Standard of Indonesia T-15-1990-03
	(gram)	(per cent)	total		
38	0	0%	0%	100%	100%
19	0	0%	0%	100%	100%
9.6	0	0%	0%	100%	100%
4.8	10148	10.00%	10.00%	90%	90 – 100%
2.4	30444	30.00%	40.00%	60%	60 – 95%
1.2	22833	22.50%	62.50%	38%	30 – 70%
0.6	20296	20.00%	82.50%	18%	15 – 34%
0.3	5074	5.00%	87.50%	13%	5 – 25%
0.15	7611	7.50%	95.00%	5%	0 – 10%
Sisa	5074	5.00%	-------	-------	---------
	101480	100%	378%		

$$FM = \frac{378}{100} = 3{,}78$$

Table 8. Coarse Aggregate Distribution Plan For Combined FM 6.00

Sieve Hole(mm)	Lagging Weight			Percentage Passed	National Standard of Indonesia T-15-1990-03
	(gram)	(per cent)	total		
38	4683.5	5.0%	5.0%	95.0%	95-100%
19	60885.5	65.0%	70%	30%	30-70%
12.5	0	0%	70%	30%	-
9.6	18734	20%	90%	10%	10-35%
4.8	9367	10%	100%	0%	0-10%
2.4	0	0%	100%	0%	0%
1.2	0	0%	100%	0%	0%
0.6	0	0%	100%	0%	0%
0.3	0	0%	100%	0%	0%
0.15	0	0%	100%	0%	0%
Sisa	0	0%	-------	-------	0%
	93670	100%	835%		

$$FM = \frac{835}{100} = 8{,}35$$

Table 9. Aggregate Distribution Plan with combined FM 6.00

Sieve Hole(mm)	Lagging Weight			Percentage Passed
	(gram)	(per cent)	total	
38	4783.5	2.4%	2.4%	98%
19	62185.5	31.54%	34.0%	66%
12.5	0	0%	34.0%	66%
9.6	19134	9.71%	43.7%	56%
4.8	19715	10.00%	53.7%	46.3%
2.4	30444	15.44%	69.1%	30.9%
1.2	22833	11.58%	80.7%	19.3%
0.6	20296	10.29%	91.0%	9.0%
0.3	5074	2.57%	93.6%	6.4%
0.15	7611	3.86%	97.4%	2.6%

Sisa	5074	2.57%	-------	-------
	197150	100%	600%	

$$FM = \frac{600}{100} = 6,00$$

From the results of the grain size distribution planning, the FM value on the fine aggregate is 3.78, and the FM coarse aggregate is 8.35, with a total FM of 6.00

The discussion of the results of this study was carried out by describing the results of sample testing, including the results of testing the compressive strength of concrete at the age of 7,14, 21, and 28 days, where the compressive strength and flexural strength of concrete were tested in the laboratory. The compressive strength test results were converted from the specimen, which is made from a cube to a cylinder. The following table describes the average compressive strength of the converted concrete:

Table 10. Average Compressive Strength of Concrete

Mixed Type	Average Compressive Strength (MPa)	Average Compressive Strength (kg/cm)
Normal Concrete	21,600	220,250
Concrete With Total FM Rated 5.00	15,799	161,101
Concrete With a total FM Rated of 5.50	20,309	207,094
Concrete With Total FM Rated 6.00	26,224	267,406

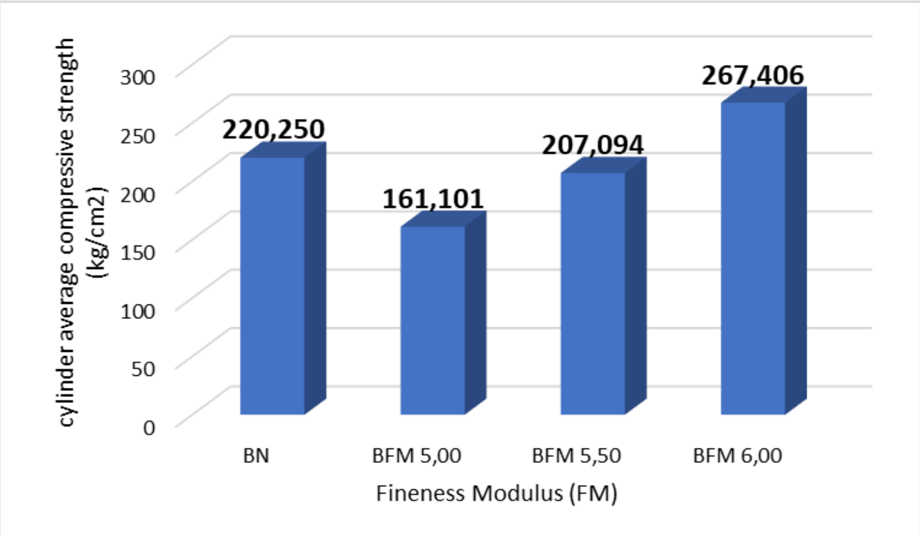

Fig 1. Average Compressive Strength of Concrete (Cylinder)

When compared to the average compressive strength of concrete with an FM value, it actually obtained 220.250 kg/cm2, while the average compressive strength of concrete with an FM value of 5.00 was 161.101 kg/cm2 decreased by 59.149 kg/cm2, concrete with an FM value of 5, 50 of 207.094 kg/cm2 decreased by 13,156 kg/cm2, and concrete with FM 6.00 value of 267.406 kg/cm2 experienced an increase of 47,156 kg/cm2. This is because the concrete with an FM value of 6.00 has grains retained on the 4.8 sieves; 2,4; 1,2; 0.6; 0.3 mm as much as 47.31%, which can fill empty cavities and provide strength to the concrete.

From the test results, the flexural strength of normal concrete is 40,788 kg/cm2, while the average flexural strength of concrete with FM 5.00 value is 40,788 kg/cm2, FM 5.50 is 47,586 kg/cm2, and the flexural strength of concrete with FM value 6.00 is 54.384 kg/cm2. The flexural strength whose FM value is distributed changes flexural strength compared to normal concrete.

Table 11. Average Bending Strength of Concrete (Beams)

Mixed Type	Size Average Flexural Strength (kg/cm2)
Normal Concrete	40,788
Concrete With Total FM Rated 5.00	40,788
Concrete With a total FM Rated of 5.50	47,586
Concrete With Total FM Rated 6.00	54,384

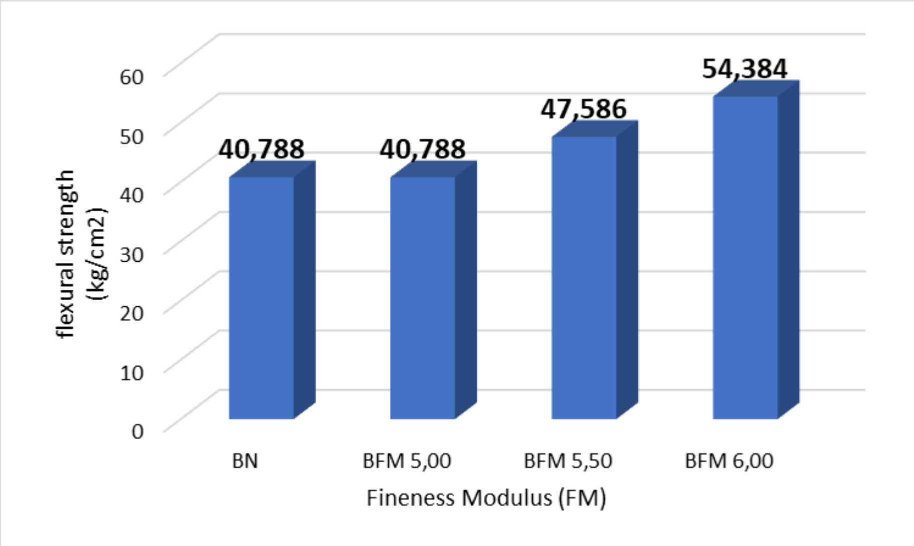

Fig 2. Average Bending Strength of Concrete (Beams)

From the results of testing the flexural strength of concrete, the following results are obtained: concrete with aggregate conditions has a flexural strength of 40.788 kg/cm2, while concrete with a value of FM 5.00 has a flexural strength of 40.788 kg/cm2 as large as normal concrete, concrete with a value of FM 5.50 has a flexural strength of 47.586 kg/cm2, an increase of 16.67% from 40.788 kg/cm2, while concrete with a value of FM 6.00 has a flexural strength of 54.384 kg/cm2, an increase of 33.33% from 40.788 kg/cm2.

V. Conclusion

The National Standard of Indonesia T-15-1990-03 regulates the composition, it is obtained that the need for fine aggregate is 101.48 kg, and coarse aggregate is 93.97 kg. By separating the grain size of the aggregate retained on a certain sieve and then distributing the grain size of the aggregate, it is obtained that the Fineness modulus requirement for fine aggregate is 2.93, and the Fineness modulus on coarse aggregate is 7.25, with a combined Fineness modulus of 5.00, then Fineness modulus. The fine aggregate is 3.40, while the coarse aggregate is 7.73, with a combined Fineness modulus of 5.50. The Fineness modulus on the fine aggregate is 3.78, and the Fineness Modulus for the coarse aggregate is 8.35, with a combined Fineness modulus of 6 00. Further, the results of the compressive strength test of concrete, the following results are obtained, the concrete in the aggregate state is used as a comparison of 220.250 kg/cm2. Concrete with FM 5.00 value decreased by 59.149 kg/cm2 or 26.85% from 220.250 kg/cm2, Concrete with FM 5.50 value decreased by 13.156 kg/cm2 or 5.97% from 220.250 kg/cm2, while Concrete with FM 6.00 value increased by 47,156 kg/cm2 or 21.41% from 220,250 kg/cm2. The higher the FM value set by SK.SNI T-15-1990-03, the higher the compressive strength of the concrete.

Meanwhile, from the results of the flexural strength test, the concrete with the actual aggregate condition was 40,788 kg/cm2. The flexural strength of this concrete was used as a comparison. The flexural strength of concrete with a value of FM 5.00 is the same as the solid concrete, the flexural strength of concrete with a value of FM 5.50 has increased by 16.67% from 40.788 kg/cm2, and the flexural strength of concrete with a value of FM 6.00 has increased by 33.33% of 40,788 kg/cm2. Testing with the distribution of fine and coarse aggregates to form a combined fineness modulus (FM) value of 5.00-5.50-6.00 can be an option for applying the packing density method. Examination of the compressive strength and flexural strength of normal concrete and its aggregated concrete is distributed so as to form a combined fineness modulus (FM) of 5.00-5.50-6.00 which can be used as an alternative test to apply the aggregate fineness modulus method to the compressive strength test and concrete bending

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