Article information

Article title

Dataset of Particle Size Distribution of Fine Aggregate sourced from Goain River (Bangladesh) and Dawki River (India) as utilized in a Batch Mixing Plant

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Keywords

Fine Aggregate visualization; Sieve analysis; River-sourced aggregates; Fine Aggregate quality; Aggregate suitability evaluation; Goain River- Bangladesh; Dawki River-India

Abstract

This data paper presents the Fine Aggregate (FA) Profile of an important river, the Goain in Bangladesh and the Dawki called in the part of India, which is a major source of natural FA for construction activities in Bangladesh. The FA Profiles were analyzed using sieve and Sand Equivalent (SE) Value of Soils and FA tests over a period of more than two years, with samples collected thrice a month from Jaflong, Sylhet, Bangladesh. The sampling method followed standard guidelines, and the sieve analysis test report satisfied

size distribution requirements, despite some fluctuations in the test results. The primary focus of this data is to present the scenario of sand availability throughout the years, which will be valuable for researchers, engineers, policymakers, and stakeholders involved in planning and designing construction projects that involve river sand. This data paper provides a comprehensive dataset on the FA Profile of the Goain (Dawki) River, which can be reused in various ways, including developing predictive models, monitoring the effects of climate change, and identifying areas for sustainable sand extraction.

Specifications table

Subject	Construction Materials
Specific subject area	Particle size distribution of Fine Aggregate.
Type of data	Table Figure Graph Chart
How the data were acquired	The Fine Aggregate Profile data presented in this data paper were directly collected from the two rivers. The instruments used for data acquisition were a sieve shaker, a set of sieves, and a graduated cylinder, dispersion agent. The data were collected by following American Society for Testing Materials (ASTM) guidelines and the sampling location was chosen to represent the typical sand composition of the river. Different machine learning techniques and Microsoft office package were used to process the data.
Data format	Raw Analyzed
Description of data collection	Fine Aggregate samples were collected from the source, Goain (Dawki) River, thrice a month for over two years. The samples were collected from

	a chosen location that represents the typical sand composition of the river, most of the sand extract from the river adjacent to that point. The data collection followed the standard guidelines.
Data source location	• Institution: Not applicable • City/Town/Region: Jaflong, Sylhet • Country: Bangladesh • Latitude and longitude (and GPS coordinates, if possible) for collected samples/data: 25.0405° N, 92.2687° E (GPS coordinates: 25°02'25.8"N 92°16'07.3"E) • Google Maps link: https://goo.gl/maps/Fi8Gzq6ppn4SWATm9
Data accessibility	Data is included with this article

Value of the data

- Provides critical information about the physical properties of natural FA for construction activities.
- Can aid in construction planning and scheduling for consistent and high-quality sand supply over the years.
- Offers insights into seasonal variations of sand characteristics over a two-year period.
- A baseline for future studies investigating changes in Fine Aggregate Profile and exploring relationships.

Objective

The main objective of this article is to offer significant information that can benefit researchers, engineers, policymakers, and stakeholders who are engaged in designing and planning construction projects that require river sand especially in Bangladesh a fast growing infrastructure perspective. Fine aggregate's physical properties are critical in the construction industry, particularly in concrete production, where the percentage of finer particles can significantly affect the concrete's setting time and strength. Therefore, the purpose of this data paper is to present comprehensive details about the Fine Aggregate Profile of the Goain River, which is a crucial source of natural fine aggregate for construction activities in the locality. Moreover, this data can serve as a valuable resource for future researchers to explore further including but not limited to seasonal variation and appropriate period of Fine Aggregate collection based on requirement.

Data description

The dataset used in this research consists of Fine Aggregate Profile data. Samples are taken in a proper manner that allows a comprehensive representation of the variations in the data. To assess the particle size distribution and quality of the sand, sieve analysis and Sand Equivalent (SE) value tests were conducted with a view to obtain Fineness Modulus (FM) and SE value.

FM refers to a numerical index used to describe the fineness or coarseness of a fine aggregate such as sand. The FM is calculated by adding the cumulative percentages of the aggregate retained on each of the standard sieves (usually 4.75mm, 2.36mm, 1.18mm, 600µm, 300µm, 150µm) and dividing the sum by 100. It is unitless.

$$\text{Fineness Modulus (FM)} = \frac{\sum \text{Cu.\% Retained in standard sieves}}{100} \quad (1)$$

The SE test is a standardized procedure used to determine the relative proportions of detrimental fine dust or clay-like materials present in a sand sample. The test evaluates the cleanliness and purity of the sand by measuring the ratio of the height of sand to the height of clay-like materials in a graduated cylinder and the measuring unit is %. The result is expressed as a SE value, usually ranging from 0 to 100, with higher values indicating cleaner and more desirable sand.

$$\text{Sand Equivalent (SE), \%} = SE = 100 \times \frac{Sand\ Reading}{Clay\ Reading} \quad (2)$$

Table 1: Sieve analysis and SE Value of Soils and FA

Test Date		**Percent Passing (%) through sieves (mm)**							**FM**	**Avg. FM**	**SE (%)**	**Avg. SE**
		9.5	**4.75**	**2.36**	**1.18**	**0.6**	**0.3**	**0.15**				
Jun-20	6/1/2020	100	97.1	88.7	70.1	32.1	7.3	2.5	3.02	2.99	95.4	94.9
	6/10/2020	100	99.5	94.3	59.5	31.7	15.0	2.5	2.98		93.2	
	6/20/2020	100	98.9	90.4	68.4	31.7	9.7	4.6	2.96		96.2	

Test Date		Percent Passing (%) through sieves (mm)							FM	Avg. FM	SE (%)	Avg. SE
		9.5	4.75	2.36	1.18	0.6	0.3	0.15				
Jul-20	7/1/2020	100	98.6	93.9	59.6	33.8	16.0	3.7	2.94	2.87	95.9	95.9
	7/10/2020	100	98.8	94.7	62.2	37.1	17.8	2.3	2.87		95.8	
	7/20/2020	100	98.1	94.4	64.4	37.5	19.5	5.2	2.81		95.9	
Aug-20	8/1/2020	100	91.9	90.3	68.7	31.9	11.5	4.1	3.02	2.99	96.7	96.5
	8/10/2020	100	99.2	89.4	67.3	31.6	9.3	3.7	3		96.3	
	8/20/2020	100	98.0	90.3	68.5	32.4	11.8	4.2	2.95		96.6	
Sep-20	9/1/2020	100	98.2	80.7	60.3	27.6	7.5	1.0	3.25	3.05	98.0	96.9
	9/10/2020	100	98.9	88.8	69.0	37.3	11.1	3.2	2.92		96.4	
	9/20/2020	100	96.9	85.6	67.7	35.9	13.1	3.3	2.98		96.3	
Oct-20	10/1/2020	100	97.8	90.6	75.0	45.3	16.2	5.0	2.7	2.85	96.4	94.7
	10/10/2020	100	98.5	81.7	65.8	33.7	21.2	9.9	2.89		93.3	
	10/20/2020	100	96.7	85.7	67.0	36.5	13.1	4.2	2.97		94.5	
Nov-20	11/1/2020	100	96.2	77.3	58.6	29.0	6.3	2.3	3.3	3.07	96.4	96.7
	11/10/2020	100	97.6	90.9	69.2	26.7	5.4	1.5	3.09		96.8	
	11/20/2020	100	98.5	90.1	73.7	40.0	12.7	3.7	2.81		96.8	
Dec-20	12/1/2020	100	98.6	90.1	62.3	43.4	25.6	5.9	2.74	2.66	94.0	93.5
	12/10/2020	100	98.4	92.9	67.5	47.7	28.5	6.3	2.59		93.9	
	12/20/2020	100	96.9	90.6	68.9	47.3	21.9	9.7	2.65		92.6	
Jan-21	1/1/2021	100	98.8	91.2	75.9	46.0	15.8	4.1	2.68	2.64	93.8	93.4
	1/10/2021	100	99.4	92.6	77.2	46.3	18.0	5.9	2.61		92.6	
	1/20/2021	100	98.8	93.1	69.6	45.4	25.4	6.0	2.62		93.8	
Feb-21	2/1/2021	100	97.4	86.4	70.6	43.5	18.7	8.3	2.75	2.67	92.9	93.0
	2/10/2021	100	98.9	91.6	76.2	46.5	18.4	7.1	2.61		92.1	
	2/20/2021	100	98.2	91.2	76.0	44.8	17.2	7.2	2.65		93.9	
Mar-21	3/1/2021	100	97.2	87.0	69.1	37.4	13.1	4.2	2.92	2.69	94.3	93.1
	3/10/2021	100	98.8	93.6	67.6	45.4	25.0	8.1	2.61		92.7	
	3/20/2021	100	98.5	94.4	69.0	46.9	28.5	8.3	2.54		92.3	
	4/1/2021	100	97.9	89.8	72.0	33.1	8.7	2.8	2.96	2.98	93.9	93.6
	4/10/2021	100	95.5	88.7	74.1	35.4	7.7	2.1	2.96		94.2	

Test Date		Percent Passing (%) through sieves (mm)							FM	Avg. FM	SE (%)	Avg. SE
		9.5	4.75	2.36	1.18	0.6	0.3	0.15				
Apr-21	4/20/2021	100	97.5	88.1	68.9	30.5	8.4	3.1	3.03		92.8	
May-21	5/1/2021	100	98.2	88.7	72.3	40.8	14.3	4.9	2.8	2.90	92.6	93.10
	5/10/2021	100	97.9	88.7	72.9	42.1	15.3	5.6	2.77		92.8	
	5/20/2021	100	97.5	84.9	66.2	25.1	11.2	3.2	3.12		93.9	
Jun-21	6/1/2021	100	96.3	88.5	70.6	38.5	9.9	2.3	2.94	2.86	94.3	94.0
	6/10/2021	100	97.9	89.2	72.7	40.7	12.6	4.1	2.83		94.5	
	6/20/2021	100	98.3	89.8	73.2	41.0	12.7	4.2	2.81		93.3	
Jul-21	7/1/2021	100	96.9	90.0	58.8	36.6	21.0	5.6	2.91	2.85	93.8	93.9
	7/10/2021	100	97.6	89.4	72.8	40.5	12.1	3.4	2.84		93.8	
	7/20/2021	100	97.9	91.3	63.7	39.4	22.4	6.9	2.79		94.1	
Aug-21	8/1/2021	100	96.4	85.4	66.9	36.4	12.9	3.9	2.98	2.91	94.7	94.2
	8/10/2021	100	98.5	92.6	75.7	33.5	7.4	2.1	2.90		93.9	
	8/20/2021	100	98.1	91.5	61.0	37.3	21.1	7.4	2.84		94.1	
Sep-21	9/1/2021	100	98.5	89.2	73.3	42.3	15.3	5.6	2.76	2.73	92	92.7
	9/10/2021	100	98.1	92.4	75.9	45.0	14.3	4.7	2.70		92.5	
	9/20/2021	100	96.3	86.5	70.8	43.0	22.5	8.8	2.72		93.5	
Oct-21	10/1/2021	100	97.8	93.4	63.4	40.9	22.8	6.9	2.75	2.72	94.1	94.0
	10/10/2021	100	97.6	92.9	65.4	44.1	28.0	10.5	2.61		93.8	
	10/20/2021	100	98.1	89.7	73.2	41.2	13.0	4.7	2.80		94	
Nov-21	11/1/2021	100	99.4	87.4	71.3	34.5	19.7	7.2	2.81	2.68	96.8	94.7
	11/10/2021	100	97.9	92.0	67.3	45.4	27.3	7.6	2.63		93.1	
	11/20/2021	100	98.1	94.1	70.3	47.1	25.9	5.8	2.59		94.1	
Dec-21	12/1/2021	100	98.0	80.3	62.9	26.9	13.1	3.6	3.15	3.01	92.8	93.2
	12/10/2021	100	98.1	91.9	65.1	44.3	23.8	4.5	2.72		93.9	
	12/20/2021	100	97.8	82.7	63.5	24.8	13.1	3.4	3.15		92.9	
Jan-22	1/1/2022	100	98.1	91.9	61.5	40.3	22.1	4.8	2.81	2.81	93.3	93.2
	1/10/2022	100	96.8	91.0	63.4	42.3	22.5	3.3	2.81		93.6	
	1/20/2022	100	98.1	92.5	62.1	39.5	21.9	5.5	2.80		92.6	
	2/1/2022	100	99.1	96.4	67.9	43.4	19.8	2.9	2.71		93.9	

Test Date		Percent Passing (%) through sieves (mm)							FM	Avg. FM	SE (%)	Avg. SE
		9.5	**4.75**	**2.36**	**1.18**	**0.6**	**0.3**	**0.15**				
Feb-22	2/10/2022	100	97.9	91.3	63.5	40.5	23.6	9.4	2.74	2.69	92.2	92.5
	2/20/2022	100	98.1	94.0	67.8	45.0	25.3	6.6	2.63		91.2	
Mar-22	3/1/2022	100	99.6	89.5	71.6	28.8	12.5	4.9	2.93	2.89	93	92.0
	3/10/2022	100	99.6	93.7	76.4	30.9	12.6	3.6	2.83		93	
	3/20/2022	100	99.0	87.0	72.1	32.5	14.5	3.5	2.91		90.1	
Apr-22	4/1/2022	100	99.6	89.5	71.6	32.4	16.2	6.4	2.84	2.66	93	94.2
	4/10/2022	100	99.0	97.1	77.0	49.9	19.8	4.4	2.53		96.7	
	4/20/2022	100	98.3	94.1	70.4	49.1	25.4	3.0	2.60		92.8	
May-22	5/1/2022	100	96.5	86.4	53.8	32.3	18.0	4.1	3.09	2.86	93.1	93.2
	5/10/2022	100	99.2	88.9	75.1	37.9	19.6	5.8	2.74		92.9	
	5/20/2022	100	97.6	93.1	64.8	41.3	21.8	6.3	2.75		93.5	
Jun-22	6/1/2022	100	97.8	89.4	73.0	37.7	19.8	5.6	2.77	2.86	92.5	93.2
	6/10/2022	100	98.5	83.1	65.5	27.5	13.5	5.3	3.07		93.4	
	6/20/2022	100	98.3	91.1	72.1	37.4	19.6	6.4	2.75		93.8	
Jul-22	7/1/2022	100	98.5	90.7	72.1	36.9	19.5	6.0	2.8	2.76	92.6	92.7
	7/10/2022	100	96.8	90.4	62.3	43.6	27.8	8.0	2.7		92.9	
	7/20/2022	100	98.8	92.0	71.3	34.7	17.2	4.5	2.8		92.5	
Aug-22	8/1/2022	100	97.5	90.8	75.0	41.6	20.6	6.3	2.7	2.75	93.7	93.2
	8/10/2022	100	96.4	88.7	59.5	39.7	24.9	7.0	2.8		92.9	
	8/20/2022	100	97.8	92.5	64.1	43.0	23.1	5.9	2.7		92.8	

The dataset comprises a total of 81 sets of data, with each record containing the following information: date of sample collection, particle size distribution measured using standard sieves of sizes 9.5mm, 4.75mm, 2.36mm, 1.18mm, 0.6mm, 0.3mm, and 0.15mm. The particle size distribution data is utilized to calculate the percent finer, which in turn is used to determine the FM of the sand. Additionally, the dataset includes the SE value. As such, the dataset encompasses both categorical and numerical data. During the data collection and processing stages, no abnormalities or issues were detected. The data underwent thorough checks, confirming its reliability and quality. Consequently, no further preprocessing was deemed necessary. The "Avg. FM" and "Avg. SE (%)" displays the average of respective calculated for each month’s tests.

Data statistic

Table 2: Database and variables.

Name of variable	Count	Mean	Stdv.	Min	25%	50%	75%	Max
%Finer Than 9.5mm	81	100	0	100	100	100	100	100
%Finer Than 4.75mm	81	97.95	1.12	91.85	97.58	98.13	98.57	99.63
%Finer Than 2.36mm	81	89.96	3.63	77.3	88.74	90.36	92.5	97.13
%Finer Than 1.18mm	81	68.42	5.23	53.75	64.37	68.93	72.33	77.22
%Finer Than 0.6mm	81	38.4	6.21	24.76	33.48	39.38	43.43	49.88
%Finer Than 0.3mm	81	17.26	6	5.4	12.7	17.21	21.88	28.54
%Finer Than 0.15mm	81	5.09	2.06	0.96	3.58	4.75	6.26	10.5
Fineness Modulus	81	2.81	0.15	2.53	2.7	2.8	2.91	3.3
Sand Equivalent (%)	81	93.94	1.51	90.1	92.9	93.8	94.3	98

It is noticed that average FM found 2.81, while it ranges from 2.53 to 3.3 with standard deviation of 0.15 And on average, the SE value is 93.94%; ranging from 90.1% to 98%. % finer than 9.5mm was 100 over the entire data collection period while average of 97.95% is finer than 4.75mm with a minimum of 91.85% and a maximum of 99.63%, average, 89.96% of the material is finer than 2.36mm has slightly more variability compared to others, ranging from 77.3% to 97.13%. The average percentage of material finer than 1.18mm is 68.42% and it shows moderate variability, with values ranging from 53.75% to 77.22%. On average, 38.40% of the material is finer than 0.6mm and it has relatively higher variability, with values ranging from 24.76% to 49.88%. The average percentage of material finer than 0.3mm is 17.26% with moderate variability, with values ranging from 5.4% to 28.54%. On average, 5.09% of the material is finer than 0.15mm with moderate variability, ranging from 0.96% to 10.5%.

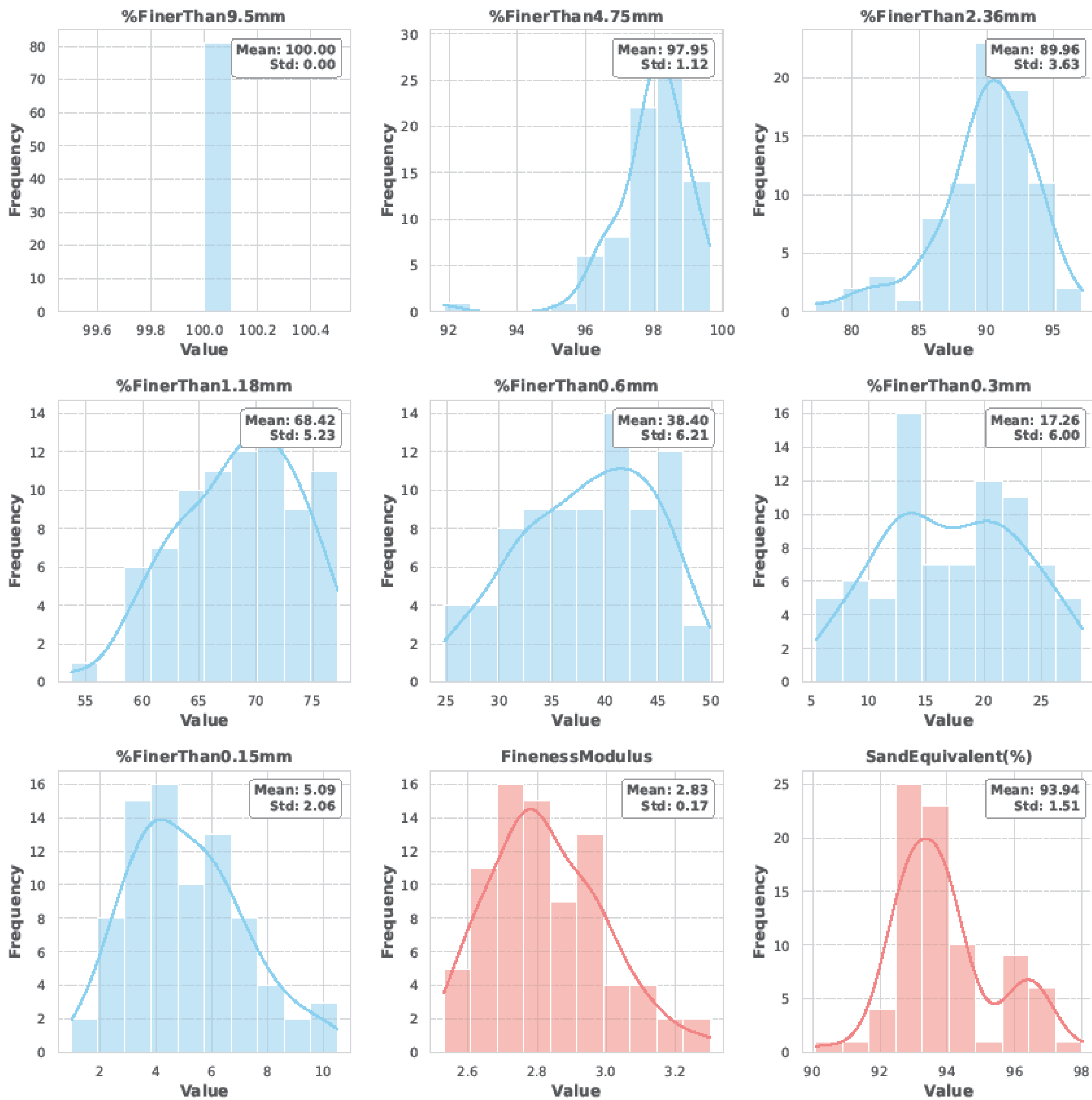

Figure 1: Histograms of Dataset

Figure 1 presents a series of histogram plots that depict the distribution of data for the inputs and outputs. These plots provide valuable insights into the frequency of occurrence for different values, as well as the central tendencies represented by the mean and standard deviation. The X-axis of the plot represents the range of % finer, while the Y-axis represents the count of occurrences for each % finer value. By visualizing the data it is easily possible to get a clearer understanding of the distribution patterns and identify any notable trends or variations.

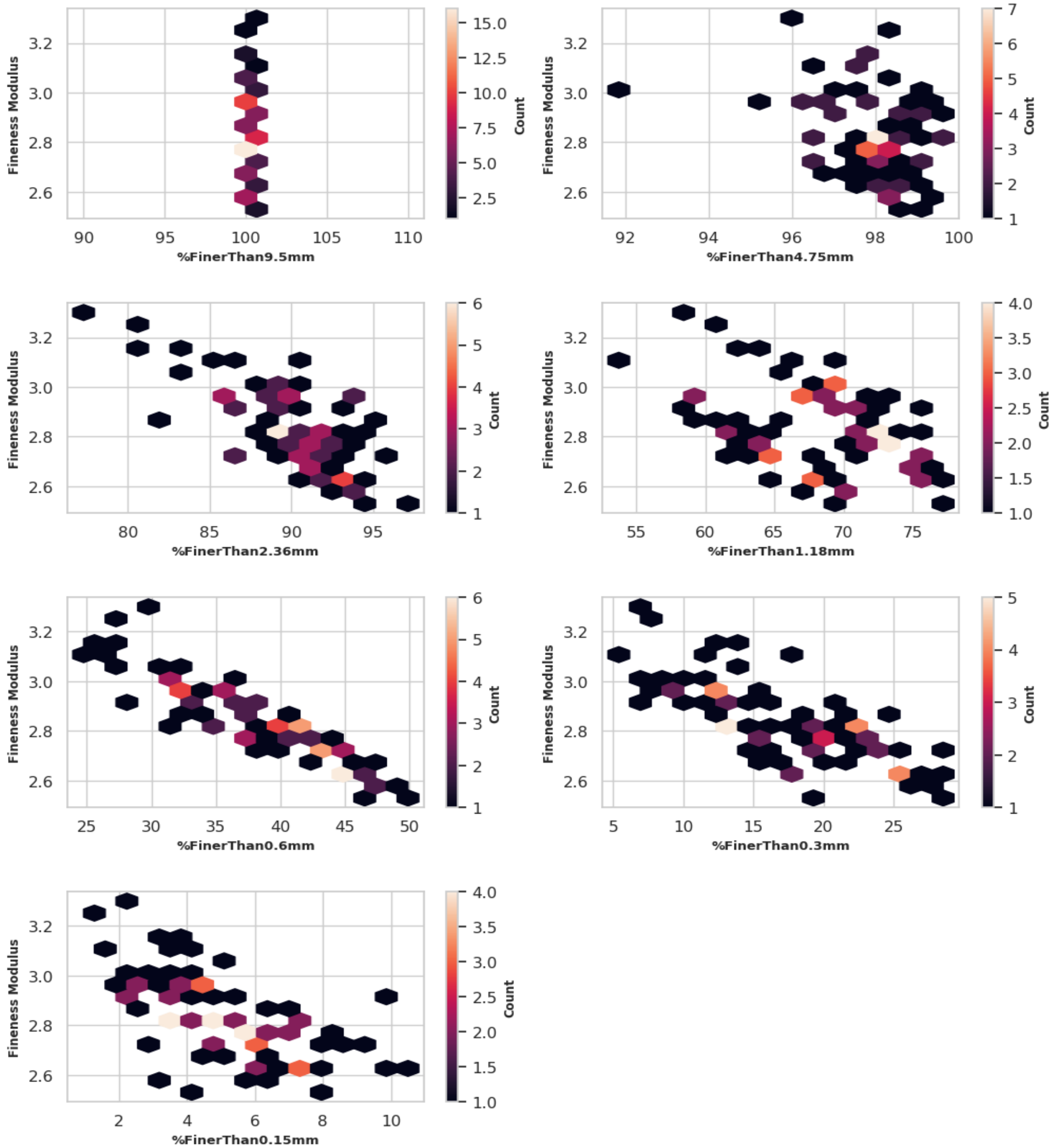

Figure 2: Hexbin plot 1 (% finer VS Fineness Modulus)

Figure 2 showcases a series of hexbin plots, which have been employed to examine the relationship between the percent finer (X-axis) of a specific size particles and the FM (Y-axis) within the research dataset. These plots offer a useful means of exploring the density and patterns. The hexagonal bins in the plot visually depict the data points, with the color intensity of each bin indicating the density of the data points within that specific region. Adjacent to the plot, a count bar is provided to aid in the interpretation and navigation of the data density across the hexagonal bins.

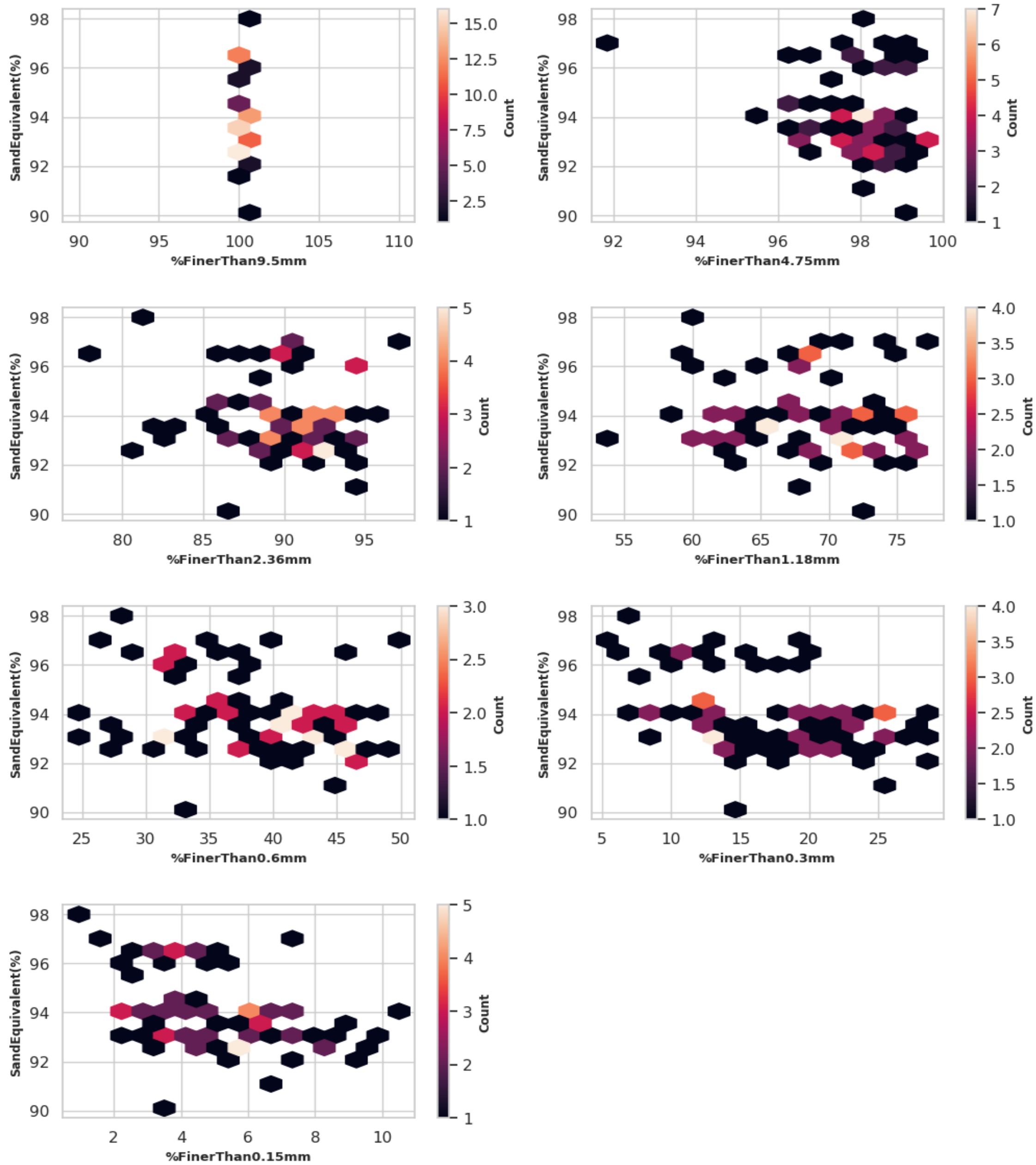

Figure 3: Hexbin plot 2 (% finer VS Sand Equivalent %)

Figure 3 presents a set of hexbin plots that highlight the relationship between the percent finer (X-axis) and the SE (Y-axis). These hexbin plots provide a visual representation of the connection between them. Through these hexbin plots, it is easier to gain insights into the distribution and clustering of data points, allows identifying any significant relationships or trends between the input and output variables.

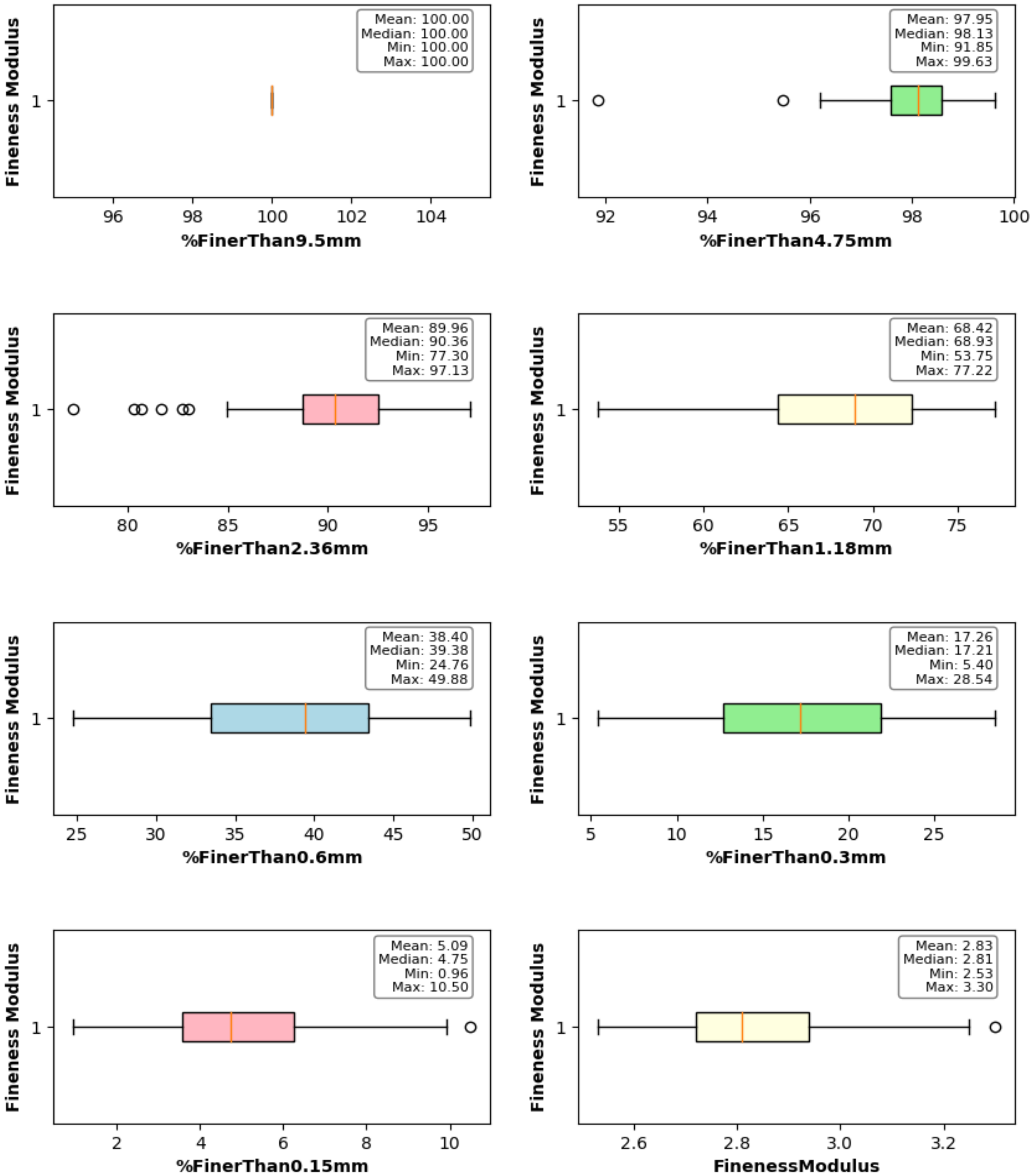

Figure 4: Box Plot 1 (% finer VS Fineness Modulus)

Figure 4 displays a set of box plots that effectively showcase the distribution and central tendency of the percent finer (X-axis) for different specific sieve in relation to the Fineness Modulus (Y-axis) of the dataset. These box plots offer a concise summary of the data's spread and key statistical measures. Each box plot consists of a rectangular box, which represents the interquartile range

(IQR) and captures the middle 50% of the data. The line within the box represents the median, which indicates the central tendency of the distribution.

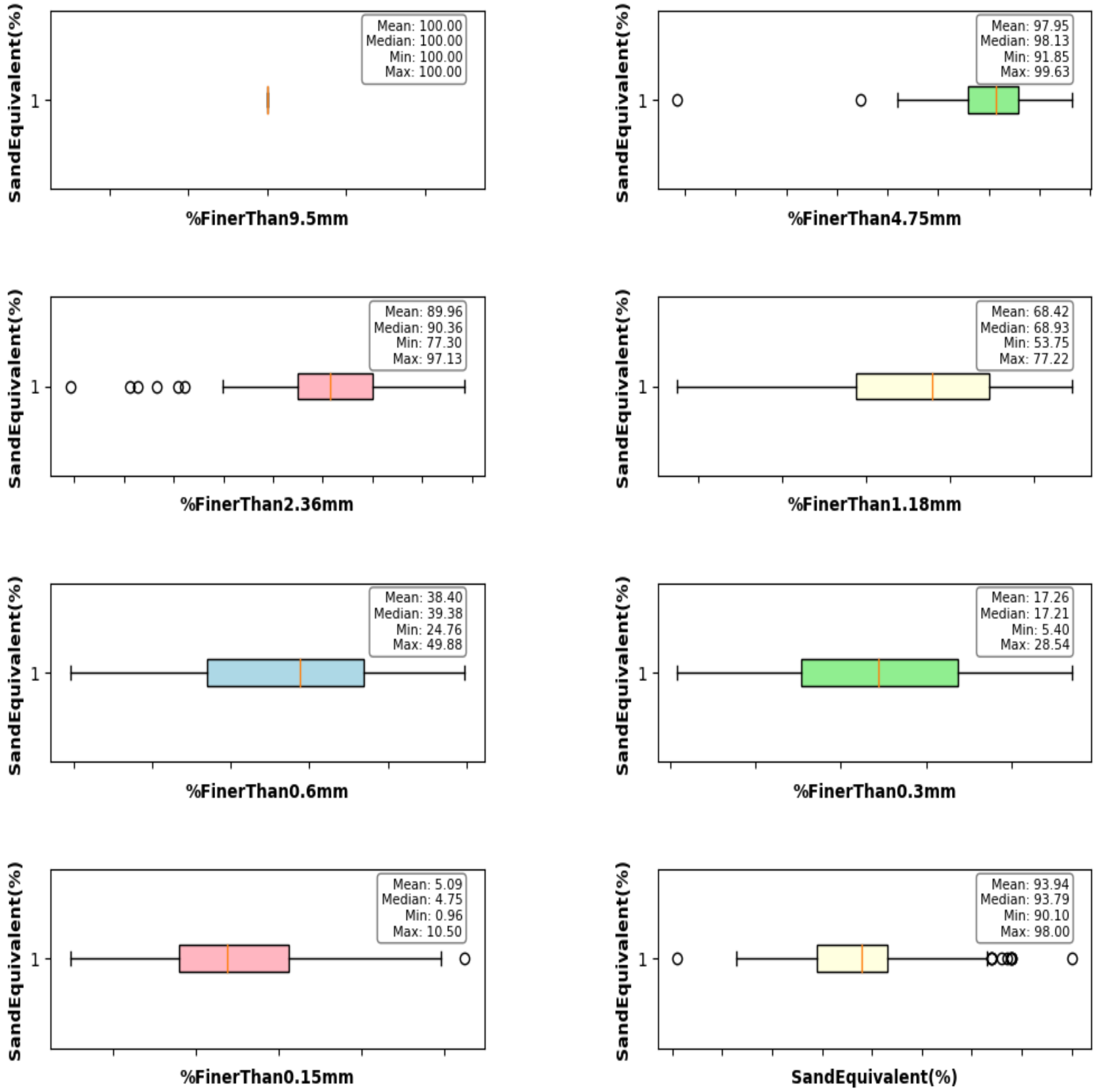

Figure 5: Box Plot 2 (% finer VS Sand Equivalent)

Figure 5 presents a set of box plots that illustrate the variation and intensity of the percent finer (X-axis) values for different sieves in relation to the Sand Equivalent (Y-axis) values of the stated dataset. The plots allow to observe the variations in % finer across different SE values, providing an indication of the intensity of % finer as SE changes. This information aids in understanding the impact of SE on the particle distribution and provides valuable insights for further analysis and interpretation of the dataset.

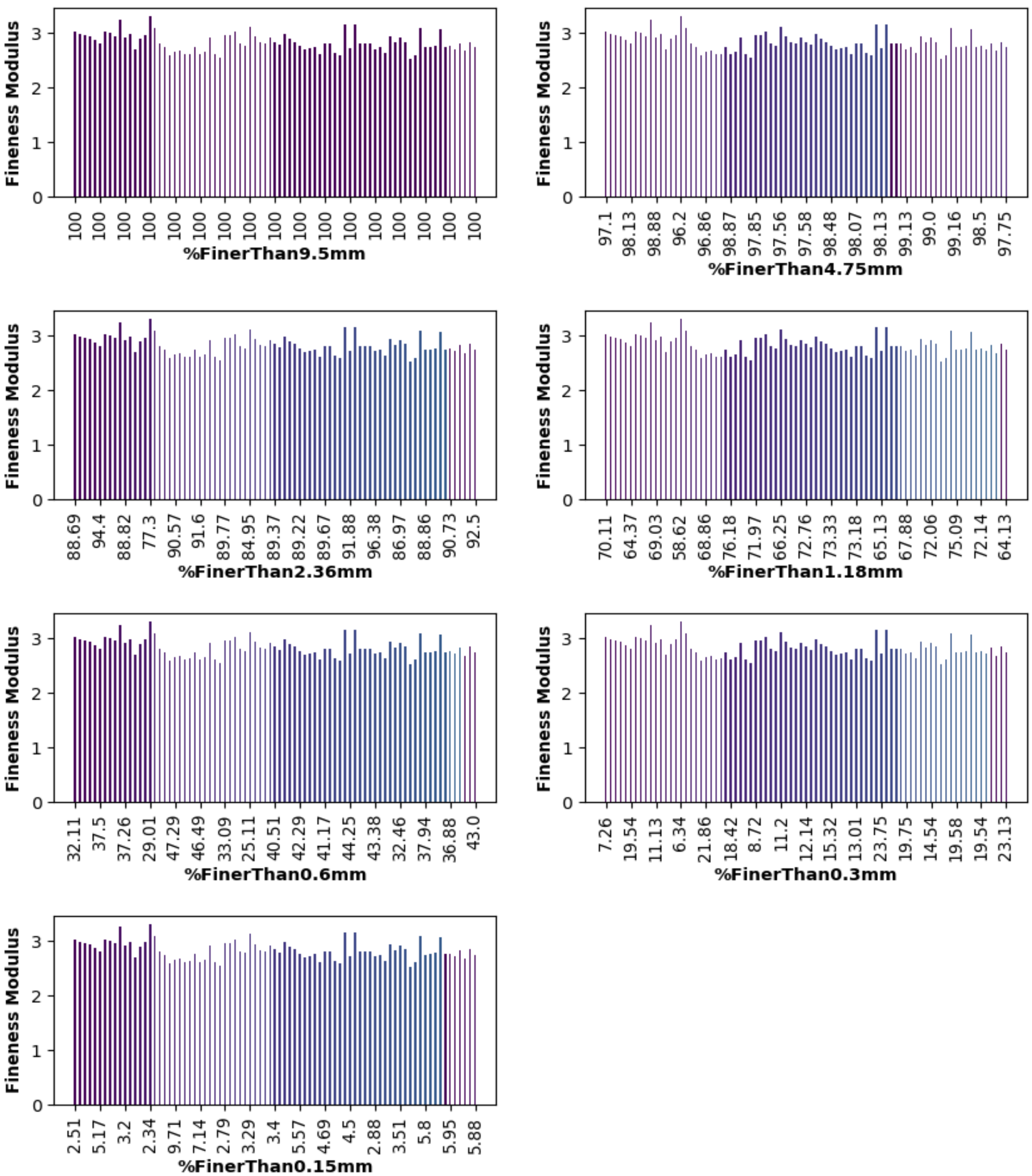

Figure 6: Bar Plot 1 (% finer VS Fineness Modulus)

Figure 6 depicts bar plots illustrating the relationship between percent finer (X-axis) and Fineness Modulus (Y-axis). The bar plots provide a visual representation of the particle size distribution and its variation across different FM values. Each bar represents a specific FM value, and its height corresponds to the percentage of finer particles for that particular FM value. This visual presentation aids in understanding the relationship between FM and the corresponding particle size distribution, allowing for a comprehensive analysis of the data.

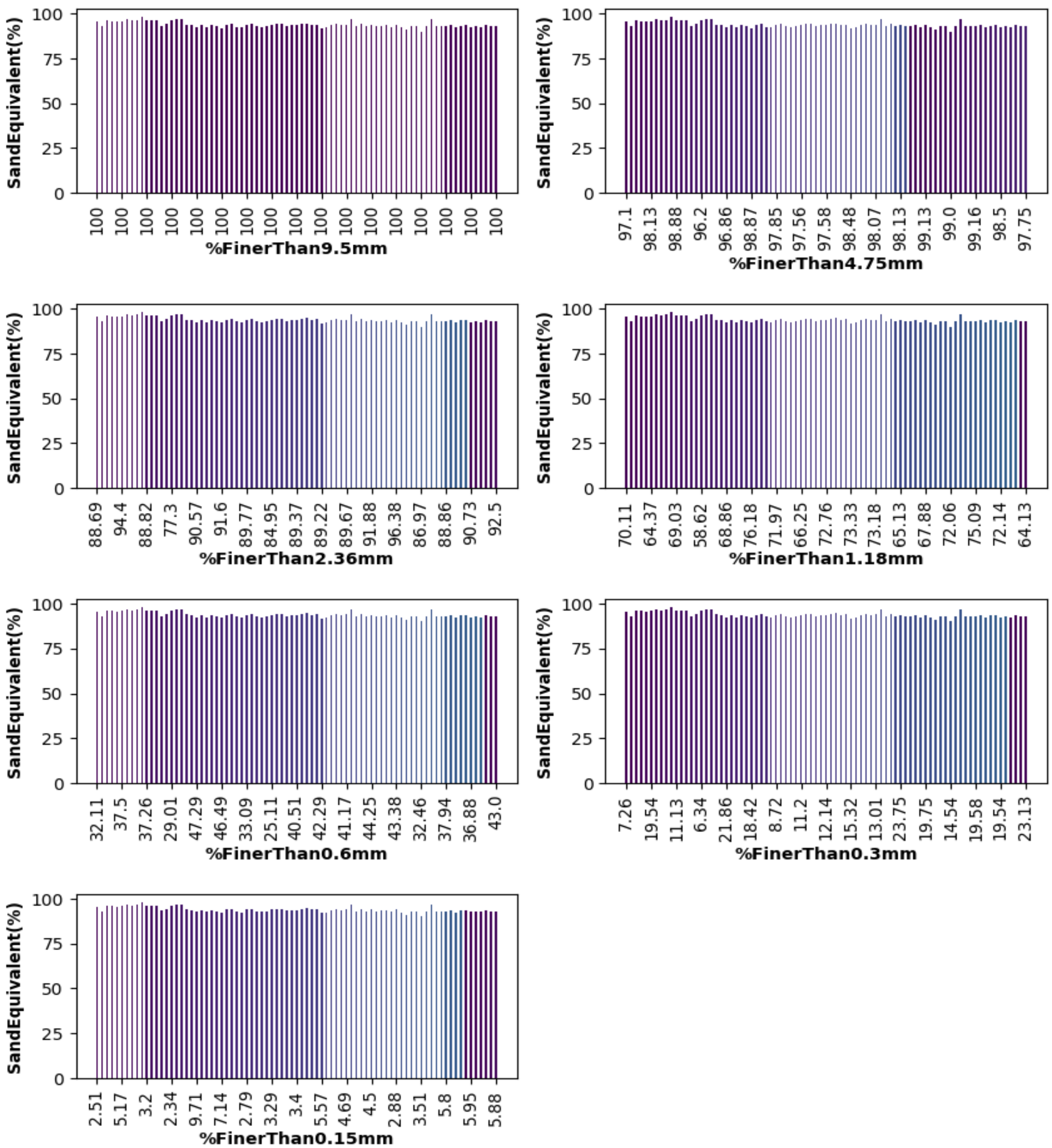

Figure 7: Bar Plot 2 (% finer VS Sand Equivalents %)

Figure 7 displays bar plots depicting the relationship between percent finer (X-axis) and Sand Equivalent (Y-axis). By examining the bar heights, it will be easier to gain insights into the distribution and variations in % finer across different SE values.

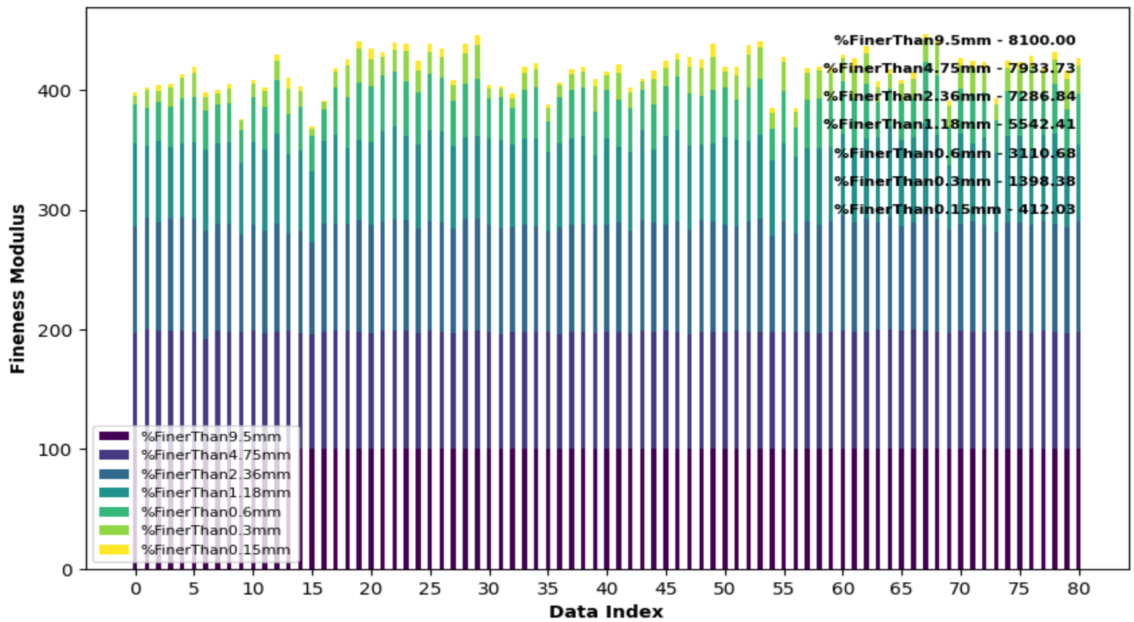

Figure 8: Stacked Bar Plot 1 (% Finer VS Fineness Modulus)

In Figure 8, Stacked Bar Plot illustrates the composition of different particle sizes distributed based on FM. The Y-axis represents the FM values, while the X-axis represents serial number of the test. Each bar is divided into color matched segments, with each segment representing a specific particle size. The height of each segment within a bar corresponds to the percentage composition of that particle size for the given FM value.

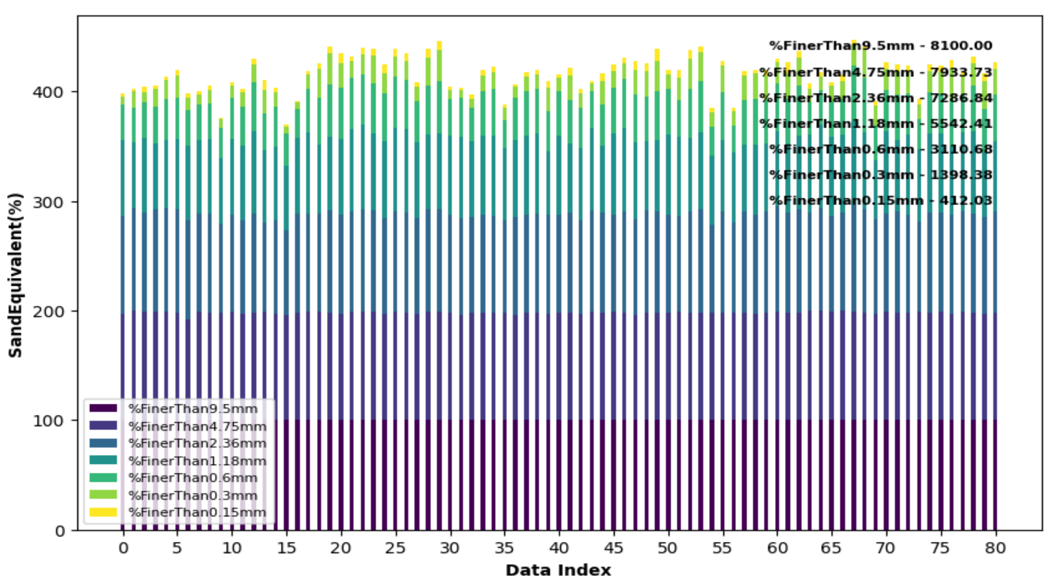

Figure 9: Stacked Bar Plot 2 (% Finer VS Sand Equivalent)

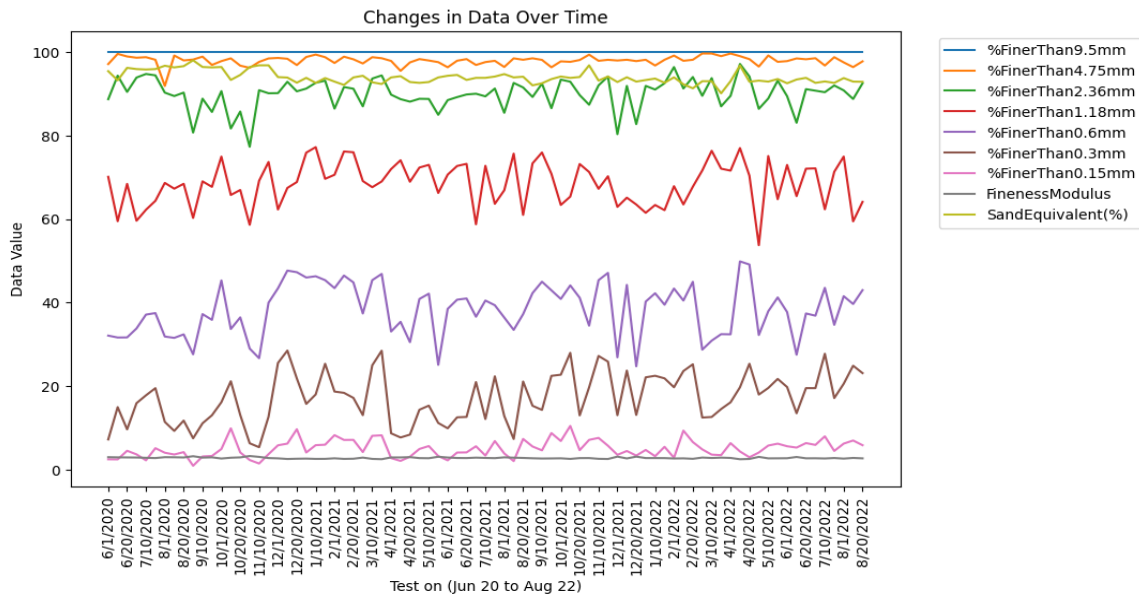

Figure 10: Observation of different fine content over time

Figure 9 shows stacked bar Plot 2, represents the composition of different particle size distributed with respect to SE. Figure 10 illustrates the trend of changes in particle size distribution from June 2020 to August 2022 whereas figure 11 shows the normalized value of the data over time. The X-axis represents the date of testing, while the Y-axis represents the values of % finers, FM and SE founds. It represents the overall variations over time. The line or data points on the graph depict the specific values obtained for each month of testing. The pattern or trend in the data points provides insights into the temporal changes in particle size distribution.

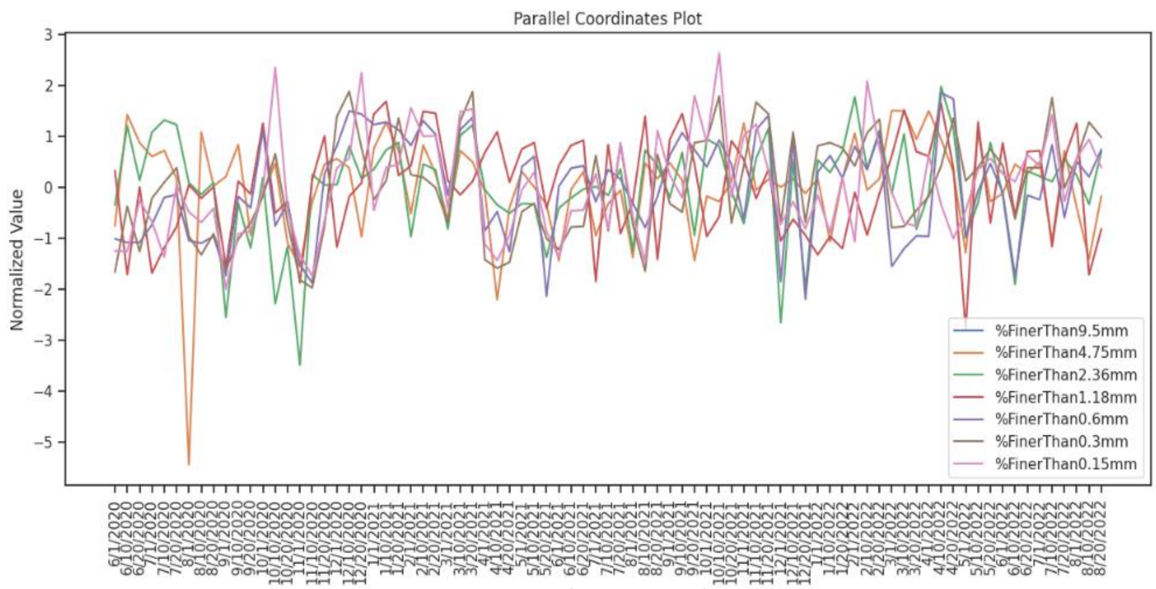

Figure 11: Normalized data over the time

In the Figure 11, the Y-axis represents normalized values, while the X-axis represents the date of the tests. This plot shows the visualization and comparison of multiple variables simultaneously.

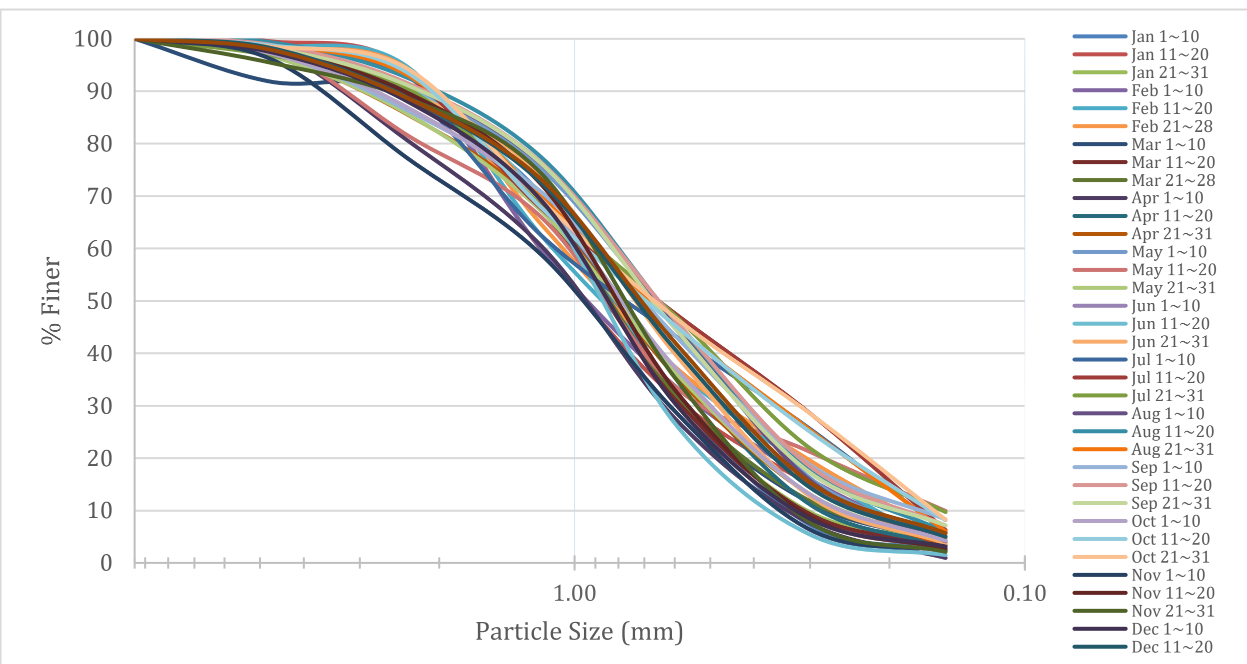

Figure 12: Particle Size distribution

Figure 12 shows the fluctuations in the percentage of finer (Y-axis) particles and size (X-axis) over time, aiming to observe any trends or patterns in the data. From the graph any notable changes or variations in the particle size distribution throughout the year can be identified.

Experimental design, materials and methods

The purpose of this was to examine the physical properties of the fine aggregate from Goain River, which is a commonly used source for construction projects in Bangladesh. To achieve this, representative samples were collected from the source three times per month and tested in the laboratory for particle size distribution and the amount of clay or silt present. The sampling was conducted according to ASTM D75/D75M-19 [1] Standard Practice for Sampling Aggregates.

To ensure consistency of the samples, three individual sets were prepared and tested separately for each test, in accordance with ASTM C136/C136M-19 [2] Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates, and ASTM D2419-14 [3] Standard Test Method for SE Value of Soils and Fine Aggregate. These tests were used to determine the particle size distribution and the SE value, respectively.

It should be noted that the values obtained from the tests varied depending on the season, however, it was observed that the gradation of the fine aggregate was always within the acceptable criteria of ASTM C33/C33M-18 [4] Standard Specification for Concrete Aggregates.

CRediT author statement

Minhaz Uddin: Data Collection, Data Curation, Writing original draft Software Aziz Ahmed: Conceptualization, Methodology, Supervision Khondaker Sakil Ahmed: Editing, Visualization, Investigation.

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Declaration of interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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