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A DETAILED STUDY ON PARTIAL REPLACEMENT OF CEMENT WITH VARIOUS PERCENTAGES OF BRICK DUST FROM DIFFERENT VARIETIES OF BRICK

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Abstract- **Brick is the most important building construction material which is widely used in residential and commercial structures. In load bearing structure the most important component of masonry walls is nothing but a brick. Brick dust is a luxurious substance produced as waste in brick kilns and building sites. This waste is dumped and utilized as landfills, which is harmful to the environment. Several creative and waste materials are used in concrete by investigators all around the world to solve environmental and economic challenges. Brick dust from several varieties of brick was used in this study project. Mainly cement replacement done with various percentage like 0%, 8%, 16%, 24%, 32% and 40%. Several number of mix are prepared with different percentage of brick dust and cast cubes, beams cylinders to perform some specified experiment Slump Test, Compressive strength Test, Flexural Strength Test and Split Tensile Test**

Keywords- **Brick, Cement, Brick Dust, Replacement Material, Constructional.**

I. INTRODUCTION

Brick dust is a luxurious substance produced as waste in brick kilns and building sites. This waste is dumped and utilized as landfills, which is harmful to the environment [1]. Several creative and waste materials are used in concrete by investigators all around the world to solve environmental and economic challenges. These waste materials produce concrete with greater or almost identical characteristics [2]. The brick kilns produce the majority of the brick dust wastes, with China being the top brick producer and India coming in second. According to the survey, both nations have more than 220,000 brick units, with China having 80,000 brick units alone. Pakistan provides around 1.5 percent of the country's GDP. These brick kilns produce brick waste in the form of brick dust, which not only takes up space but also poses a health and environmental risk. Because cement is the most expensive component of concrete, it should be used sparingly. Researchers have employed a variety of inventive and waste resources to overcome the expense of concrete in this way. Fly ash, silica fume, marble dust, stone dust, and a variety of other elements are among them.

Brick dust is produced during the loading and unloading of bricks, as well as at building sites and brick kilns. This dust is utilized in the dumping and filling of containers [1]. Thousands of tonnes of brick trash are manufactured each year across the world, and it is disposed of in an uncontrolled manner. Since ancient periods, pozzolanic elements including such brick dust as well as other ceramic powders have been utilized in concrete [4]. Because they were uninformed of the qualities of brick dust in ancient periods, they employed it based on their experience and trials.

The impact of employing brick dust in cement concrete is investigated in this study. All of the mixes with varied percentages of cement substituted with brick dust showed a tendency of variance in workability, compressive strength, and tensile strength [3-4]. Individually and concurrently, the mixes were made by substituting cement with brick dust. In both brick dust and lime powder, the results reveal an improving trend in workability as compared to the control mix. When brick dust is added to concrete, the compressive and tensile strength decreases, but lime powder itself increases strength. Utilizing brick dust in concrete at the same time gives us such a comparative strength concrete while also lowering the cost of concrete.

II. USED MIX FORMULATION

In the table 1 to 4 shown the percentage of brunt 1st class brick dust as replacement of cement, percentage of concrete brick dust as replacement of cement, percentage of lime brick dust as replacement of cement and percentage of fly ash brick dust as replacement of cement respectively.

Table 1: Percentage of Brunt 1st class Brick Dust as Replacement of Cement

Mix	Brunt 1st Class Brick Dust	Cement	Sand	Aggregate
Standard	0%	100%	100%	100%
Mix-A-1	8%	92%	100%	100%
Mix-A-2	16%	84%	100%	100%
Mix-A-3	24%	76%	100%	100%
Mix-A-4	32%	68%	100%	100%
Mix-A-5	40%	60%	100%	100%

Table 2: Percentage of Concrete Brick Dust as Replacement of Cement

Mix	Concrete Brick Dust	Cement	Sand	Aggregate
Standard	0%	100%	100%	100%
Mix-B-1	8%	92%	100%	100%
Mix-B-2	16%	84%	100%	100%
Mix-B-3	24%	76%	100%	100%
Mix-B-4	32%	68%	100%	100%
Mix-B-5	40%	60%	100%	100%

Table 3: Percentage of Lime Brick Dust as Replacement of Cement

Mix	Lime Brick Dust	Cement	Sand	Aggregate
Standard	0%	100%	100%	100%
Mix-C-1	8%	92%	100%	100%
Mix-C-2	16%	84%	100%	100%
Mix-C-3	24%	76%	100%	100%
Mix-C-4	32%	68%	100%	100%
Mix-C-5	40%	60%	100%	100%

Table 4: Percentage of Fly Ash Brick Dust as Replacement of Cement

Mix	Fly Ash Brick Dust	Cement	Sand	Aggregate
Standard	0%	100%	100%	100%
Mix-D-1	8%	92%	100%	100%
Mix-D-2	16%	84%	100%	100%
Mix-D-3	24%	76%	100%	100%
Mix-D-4	32%	68%	100%	100%
Mix-D-5	40%	60%	100%	100%

III. RESULT & DISCUSSION

Results of Concrete Test

A. Slump Test

Table 5: Slump test of Varying Percentage of Brunt 1st class Brick Dust as Replacement of Cement

Mix	Brunt 1st Class Brick Dust	Cement	Slump (mm)
Standard	0%	100%	53
Mix-1	8%	92%	68
Mix2	16%	84%	80
Mix-3	24%	76%	86
Mix 4	32%	68%	92
Mix-5	40%	60%	94

Table 6: Slump test of Varying Percentage of Concrete Brick Dust as Replacement of Cement

Mix	Concrete Brick Dust	Cement	Slump (mm)
Standard	0%	100%	53
Mix-1	8%	92%	65
Mix2	16%	84%	76
Mix-3	24%	76%	91
Mix 4	32%	68%	98
Mix-5	40%	60%	102

Table 7: Slump test of Varying Percentage of Lime Brick Dust as Replacement of Cement

Mix	Lime Brick Dust	Cement	Slump (mm)
Standard	0%	100%	53
Mix-1	8%	92%	64
Mix2	16%	84%	76
Mix-3	24%	76%	82
Mix 4	32%	68%	88
Mix-5	40%	60%	90

Table 8: Slump test of Varying Percentage of Fly Ash Brick Dust as Replacement of Cement

Mix	Fly Ash Brick Dust	Cement	Slump (mm)
Standard	0%	100%	53
Mix-1	8%	92%	66
Mix2	16%	84%	73
Mix-3	24%	76%	85
Mix 4	32%	68%	92

B. Compressive strength Test

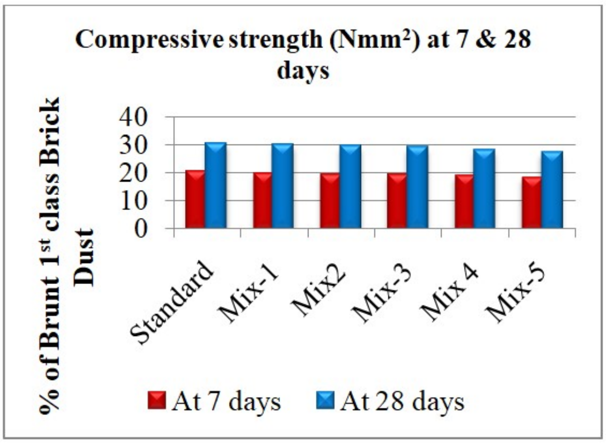

Fig. 1: Compressive strength at 7& 28 days of Varying Percentage of Brunt 1st class Brick Dust as Replacement of Cement

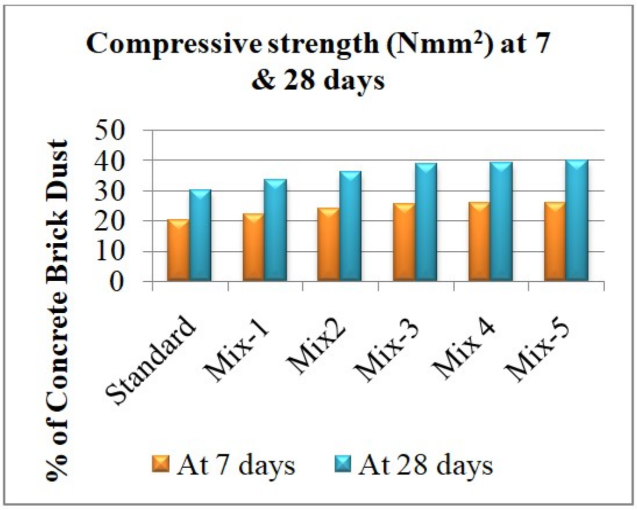

Fig. 2: Compressive strength at 7 & 28 days of Varying Percentage of Concrete Brick Dust as Replacement of Cement

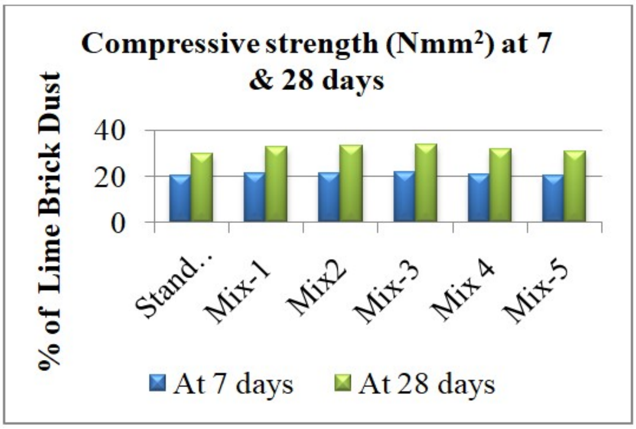

Fig. 3: Compressive strength at 7 & 28 days of Varying Percentage of Lime Brick Dust as Replacement of Cement

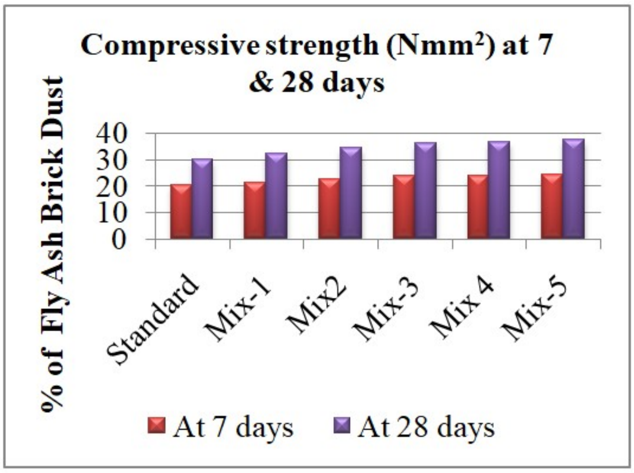

Fig. 4: Compressive strength at 28 days of Varying Percentage of Fly Ash Brick Dust as Replacement of Cement

C. Test Flexural Strength Test (7days and 28 Days)

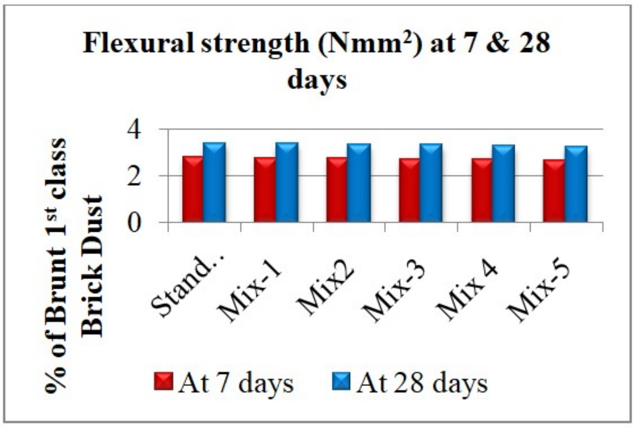

Fig. 5: Flexural strength at 7 & 28 days of Varying Percentage of Brunt 1st class Brick Dust as Replacement of Cement

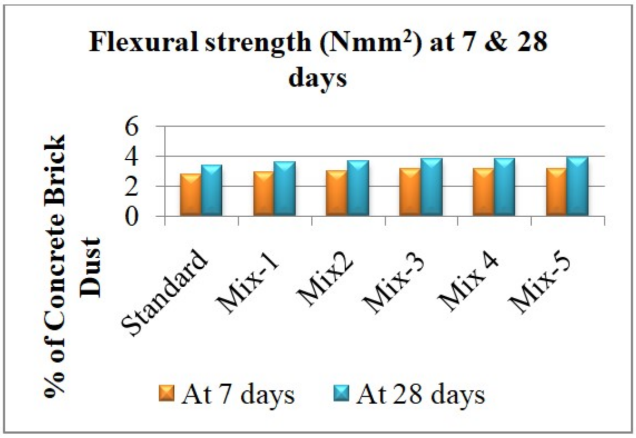

Fig. 6: Flexural strength at 7 & 28 days of Varying Percentage of Concrete Brick Dust as Replacement of Cement

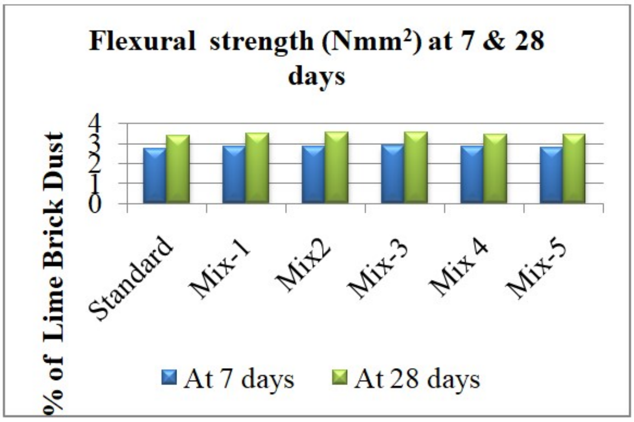

Fig. 7: Flexural strength at 7 & 28 days of Varying Percentage of Lime Brick Dust as Replacement of Cement

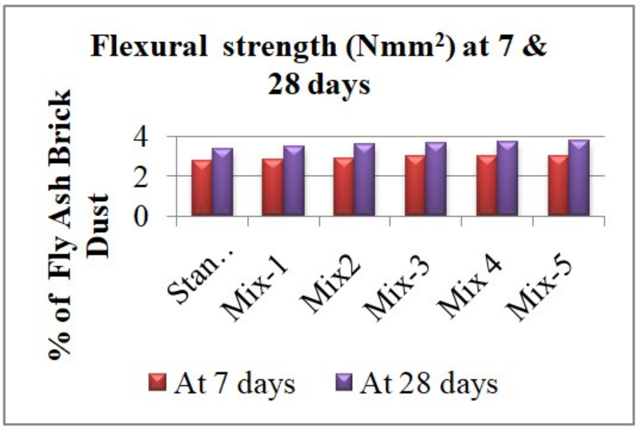

Fig. 8: Flexural strength at 7 & 28 days of Varying Percentage of Fly Ash Brick Dust as Replacement of Cement

D. Split Tensile (7days and 28 Days)

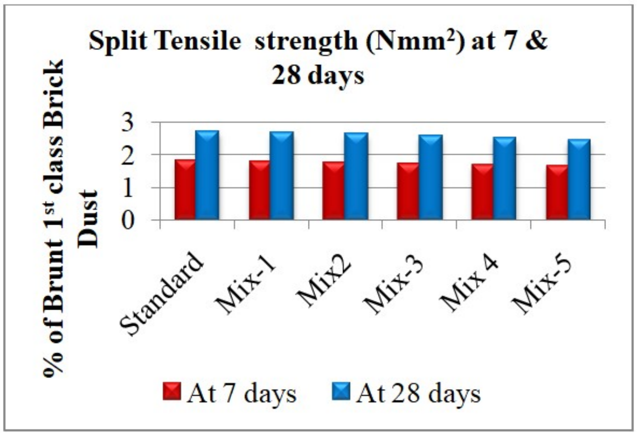

Fig. 9: Split Tensile at 7 & 28 days of Varying Percentage of Brunt 1st class Brick Dust as Replacement of Cement

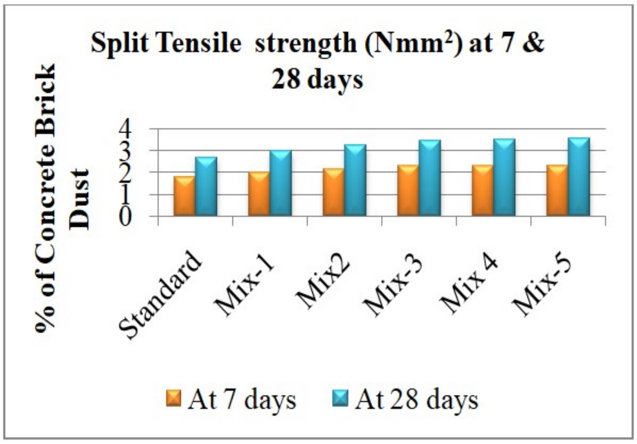

Fig. 10: Split Tensile at 7 & 28 days of Varying Percentage of Concrete Brick Dust as Replacement of Cement

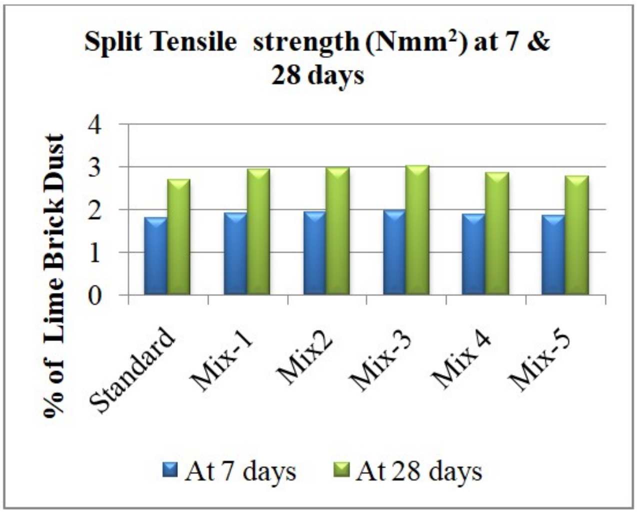

Fig. 11: Split Tensile at 7& 28 days of Varying Percentage of Lime Brick Dust as Replacement of Cement

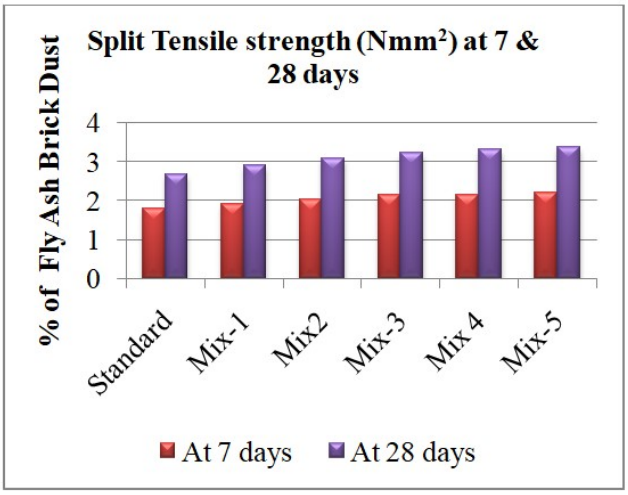

Fig. 12: Split Tensile at 7 & 28 days of Varying Percentage of Fly Ash Brick Dust as Replacement of Cement

IV. CONCLUSION

- Maximum Value of Slump of concrete 94mm at 40% Percentage of Brunt 1st class Brick Dust as Replacement of Cement linearly increases as addition of Brunt 1st class brick dust.
- Maximum Value of Slump of concrete 102mm at 40% Percentage of Concrete Brick Dust as Replacement of Cement linearly increases as addition of Concrete brick dust.
- Maximum Value of Slump of concrete 90mm at 40% Percentage of Lime Brick Dust as Replacement of Cement linearly increases as addition of Lime brick dust.
- Maximum Value of Slump of concrete 96mm at 40% Percentage of Fly ash Brick Dust as Replacement of Cement linearly increases as addition of Fly ash brick dust.
- Compressive strength of concrete sample at 7 days due to Varying Percentage of Brunt 1st class Brick Dust as Replacement of Cement decreases as addition of Brunt 1st class brick dust. Maximum value of compressive strength occurs 20.27N/mm2 at 0% and minimum value of compressive strength occurs 18.23N/mm2 at 40% as addition of Brunt 1st class Brick Dust.
- Compressive strength of concrete sample at 28 days due to Varying Percentage of Brunt 1st class Brick Dust as Replacement of Cement decreases as addition of Brunt 1st class brick dust. Maximum value of compressive strength occurs 30.04N/mm2 at 0% and minimum value of compressive strength occurs 27.13N/mm2 at 40% as addition of Brunt 1st class Brick Dust.
- Compressive strength of concrete sample at 7 days due to Varying Percentage of Concrete Brick Dust as Replacement of Cement decreases as addition of Concrete brick dust. Maximum value of compressive strength occurs 26.04N/mm2 at 40% and minimum value of compressive strength occurs 20.27N/mm2 at 0% as addition of Concrete Brick Dust.
- Compressive strength of concrete sample at 28 days due to Varying Percentage of Concrete Brick Dust as Replacement of Cement decreases as addition of Concrete dust. Maximum value of compressive strength occurs 39.83N/mm2 at 40% and minimum value of compressive strength occurs 30.04N/mm2 at 0% as addition of Concrete Brick Dust.
- Compressive strength of concrete sample at 7 days due to Varying Percentage of Concrete Brick Dust as Replacement of Cement decreases as addition of Lime brick dust. Maximum value of compressive strength

occurs 21.99N/mm2 at 24% and minimum value of compressive strength occurs 20.27N/mm2 at 0% as addition of Lime Brick Dust.

- Compressive strength of concrete sample at 28 days due to Varying Percentage of Concrete Brick Dust as Replacement of Cement decreases as addition of Lime dust. Maximum value of compressive strength occurs 33.78N/mm2 at 24% and minimum value of compressive strength occurs 30.04N/mm2 at 0% as addition of Lime Brick Dust.
- Compressive strength of concrete sample at 7 days due to Varying Percentage of Concrete Brick Dust as Replacement of Cement decreases as addition of Fly ash brick dust. Maximum value of compressive strength occurs 24.61N/mm2 at 40% and minimum value of compressive strength occurs 20.27N/mm2 at 0% as addition of Fly ash Brick Dust.
- Compressive strength of concrete sample at 28 days due to Varying Percentage of Concrete Brick Dust as Replacement of Cement decreases as addition of Fly ash dust. Maximum value of compressive strength occurs 37.87N/mm2 at 40% and minimum value of compressive strength occurs 30.04N/mm2 at 0% as addition of Fly ash Brick Dust.
- Flexural strength of concrete sample at 7 days due to Varying Percentage of Brunt 1st class Brick Dust as Replacement of Cement decreases as addition of Brunt 1st class brick dust. Maximum value of Flexural strength occurs 2.764N/mm2 at 0% and minimum value of Flexural strength occurs 2.622N/mm2 at 40% as addition of Brunt 1st class Brick Dust.
- Flexural strength of concrete sample at 28 days due to Varying Percentage of Brunt 1st class Brick Dust as Replacement of Cement decreases as addition of Brunt 1st class brick dust. Maximum value of Flexural strength occurs 3.365N/mm2 at 0% and minimum value of Flexural strength occurs 3.198N/mm2 at 40% as addition of Brunt 1st class Brick Dust.
- Flexural strength of concrete sample at 7 days due to Varying Percentage of Concrete Brick Dust as Replacement of Cement decreases as addition of Concrete brick dust. Maximum value of Flexural strength occurs 3.133N/mm2 at 40% and minimum value of Flexural strength occurs 2.764N/mm2 at 0% as addition of Concrete Brick Dust.
- Flexural strength of concrete sample at 28 days due to Varying Percentage of Concrete Brick Dust as Replacement of Cement decreases as addition of Concrete dust. Maximum value of Flexural strength occurs 3.875N/mm2 at 40% and minimum value of Flexural strength occurs 3.365N/mm2 at 0% as addition of Concrete Brick Dust.
- Flexural strength of concrete sample at 7 days due to Varying Percentage of Lime Brick Dust as Replacement of Cement decreases as addition of Lime brick dust. Maximum value of Flexural strength occurs 2.879N/mm2 at 24% and minimum value of Flexural strength occurs 2.764N/mm2 at 0% as addition of Lime Brick Dust.
- Flexural strength of concrete sample at 28 days due to Varying Percentage of Lime Brick Dust as Replacement of Cement decreases as addition of Lime dust. Maximum value of Flexural strength occurs 3.569N/mm2 at 24% and minimum value of Flexural strength occurs 3.365N/mm2 at 0% as addition of Lime Brick Dust.
- Flexural strength of concrete sample at 7 days due to Varying Percentage of Fly ash Brick Dust as Replacement of Cement decreases as addition of Fly ash brick dust. Maximum value of Flexural strength occurs 3.046N/mm2 at 40% and minimum value of Flexural strength occurs 2.764N/mm2 at 0% as addition of Fly ash Brick Dust.
- Flexural strength of concrete sample at 28 days due to Varying Percentage of Fly ash Brick Dust as Replacement of Cement decreases as

addition of Fly ash dust. Maximum value of Flexural strength occurs 3.778N/mm2 at 40% and minimum value of Flexural strength occurs 3.365N/mm2 at 0% as addition of Fly ash Brick Dust.

- Split tensile strength of concrete sample at 7 days due to Varying Percentage of Brunt 1st class Brick Dust as Replacement of Cement decreases as addition of Brunt 1st class brick dust. Maximum value of Split tensile strength occurs 1.814N/mm2 at 0% and minimum value of Split tensile strength occurs 1.632N/mm2 at 40% as addition of Brunt 1st class Brick Dust.
- Split tensile strength of concrete sample at 28 days due to Varying Percentage of Brunt 1st class Brick Dust as Replacement of Cement decreases as addition of Brunt 1st class brick dust. Maximum value of Split tensile strength occurs 2.689N/mm2 at 0% and minimum value of Split tensile strength occurs 2.428N/mm2 at 40% as addition of Brunt 1st class Brick Dust.
- Split tensile strength of concrete sample at 7 days due to Varying Percentage of Concrete Brick Dust as Replacement of Cement decreases as addition of Concrete brick dust. Maximum value of Split tensile strength occurs 2.331N/mm2 at 40% and minimum value of Split tensile strength occurs 1.814N/mm2 at 0% as addition of Concrete Brick Dust.
- Split tensile strength of concrete sample at 28 days due to Varying Percentage of Concrete Brick Dust as Replacement of Cement decreases as addition of Concrete dust. Maximum value of Split tensile strength occurs 3.565N/mm2 at 40% and minimum value of Split tensile strength occurs 2.689N/mm2 at 0% as addition of Concrete Brick Dust.
- Split tensile strength of concrete sample at 7 days due to Varying Percentage of Lime Brick Dust as Replacement of Cement decreases as addition of Lime brick dust. Maximum value of Split tensile strength occurs 1.968N/mm2 at 24% and minimum value of Split tensile strength occurs 1.814N/mm2 at 0% as addition of Lime Brick Dust.
- Split tensile strength of concrete sample at 28 days due to Varying Percentage of Lime Brick Dust as Replacement of Cement decreases as addition of Lime dust. Maximum value of Split tensile strength occurs 3.023N/mm2 at 24% and minimum value of Split tensile strength occurs 2.689N/mm2 at 0% as addition of Lime Brick Dust.
- Split tensile strength of concrete sample at 7 days due to Varying Percentage of Fly ash Brick Dust as Replacement of Cement decreases as addition of Fly ash brick dust. Maximum value of Split tensile strength occurs 2.203N/mm2 at 40% and minimum value of Split tensile strength occurs 1.814N/mm2 at 0% as addition of Fly ash Brick Dust.
- Split tensile strength of concrete sample at 28 days due to Varying Percentage of Fly ash Brick Dust as Replacement of Cement decreases as addition of Fly ash dust. Maximum value of Split tensile strength occurs 3.389N/mm2 at 40% and minimum value of Split tensile strength occurs 2.689N/mm2 at 0% as addition of Fly ash Brick Dust.

V. REFERENCES

[1] Anayat Ali and Shamshad Alam, “Partial Replacement of Fine Aggregate with Brick Dust” International Journal of Technical Innovation in Modern Engineering & Science, 5(04), pp 77-80, 2019.

[2] Mehtab Alam and Hemant Kumar Sain, “Partial Replacement of Cement with Kota Stone Slurry Powder and Coal Ash in High Performance Concrete”, Design Engineering, pp. 1094- 1102, 2021.

[3] R. Ilangovan, N. Mahendran and K. Nagamani, "Strength and durability properties of concrete containing quarry rock dust as fine aggregates", ARPN Journal of Engineering and Applied Science, Vol.3(5), pp.20-26, 2008.

[4] M. R. Wakchaure., A. P. Shaikh and B. E. Gite, “Effect of Types of Fine Aggregate on Mechanical Properties of Cement Concrete”, International Journal of Modern Engineering Research (IJMER), Vol. 2, Issue. 5, pp. 3723-3726, 2012.

[5] Mehtab Alam and Hemant Kumar Sain, “An Experimental Study on Partial Replacement of Cement with Kota Stone Slurry Powder and Coal Ash in High Performance Concrete”, International Journal of Engineering Trends and Applications (IJETA), vol. 8, pp. 12-18, 2021.

[6] Rehan Arif, Anwar Khitab, Mehmet Serkan Kırgız, Raja Bilal Nasar Khan, Seemab Tayyab, Riaz Akhtar Khan, Waqas Anwar, Muhammad Tausif Arshad, "Experimental analysis on partial replacement of cement with brick powder in concrete", Case Studies in Construction Materials, pp. 1-14, 2021.