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Partial Replacement of Cement with Kota Stone Slurry Powder and Fly Ash in High Performance Concrete

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Abstract

This examination is for assessing, mineral admixture, such as , Fly ash and Kota stone slurry powder , influence in solid when it is blended in bond concrete for usefulness, solidness and quality of solid utilizing OPC (43 grade). Fly ash is strengthening cementations material and Kota stone slurryis pozzolanic materials that can be used to make profoundly sturdy solid composites. In this examination Fly ash has been utilized to supplant OPC which fluctuates from 2.5% to 10% at interim of 2.5% by absolute load of OPC and comparably bond has been supplant by Kota stone slurry which differs 5% to 20% at interim of 5% by all out weight of OPC.. This examination researches the exhibition of cement under impact of Fly ash and Kota stone slurry powderas far as droop, Compressive quality 7 days and 28 days utilizing block (150mm x 150mm x 150mm) example, Flexural quality for 28 days utilizing shaft (700mm x 150mm x 150mm) and part rigidity for 28 days utilizing chamber (300mm length x 150mm distance across) were evaluated for this investigation by throwing these in establishment lab. All these solid examples were relieved for 7 days and 28 days in profound water tank on ordinary 27+20C degree air temperature.

Keywords:- Concrete, Fly ash, Kota stone slurry powder ,Workability, Compressive Strength, Flexural Strength, Splitting Tensile Strength

Introduction

India is the largest producer of stone raw materials from world after China and Italy. During the treatment of Cut, finish and polish the stones in large quantities waste is generated in the form of stone mud and dust. This stone dust is sediment and then evacuated, which leads to pollution of the environment. The use of this dust in various industrial sectors, particularly construction, would help protect the environment. Stone residues can be used as a partial replacement for a fine aggregate and as an additional ingredient to achieve certain desired properties of the concrete. As Kota stone is a variety of fine-grained limestone, this slurry of stone, thanks to its fineness, can be used as filling material to fill the voids chloride ion penetration by the formation of a dense microstructure. Cement is also one of the most used materials in the world. This rapid production of cement creates environmental problems for which we must discover civil engineering solutions. About 0.9 tons of carbon dioxide is released into the atmosphere when producing a grade of normal Portland cement. Since there is no alternative connecting material that completely replaces cement, the use of partial cement substitution is well accepted for concrete composites. As a cementations material, granulated blast furnace slag, fly ash and silica fume can be used and concrete properties can be improved when fresh and hydrated. Ground blast furnace slag can also be used as premium water reducers to improve compressive strength or workability. Crushed blast furnace slag is

known to produce high strength concrete and is used as a substitute for cement to reduce cement content (generally for economic reasons) and as an additive to improve concrete properties in concrete [2].

Proportion of Fly Ash and Kota Stone Slurry Powder with Control Mix

In this blend of control mix, the variations had been made with cement. Replace few percentage of cement with Fly ash and Kota stone slurry powder which varies from (Fly ash 0% to 10% at interval of 2.5%) and (Kota stone 5% to 20 % at interval of 5%) for both concrete mixes of M45 & M50.

Table 1: Replacement of OPC by Fly ash & Kota stone slurry powder for M45

S. No	Mix Name	Cement (Kg)	Kota stone slurry powder (kg)	Fly ash(Kg)	Coarse Aggregate(Kg)		Fine Aggregate (Kg)	Water (Kg)	Admixture (Kg)
					20mm	10mm			
1	OPC+Kota stone slurry powder + Fly ash(100+0+0)	479.9	0.00	0.00	680.1	400	722	168	3.844
2	OPC+ Kota stone slurry powder + Fly ash (92.5+5+2.5)	443.9	23.99	11.99	680.1	400	722	168	3.844
3	OPC+ Kota stone slurry powder+ Fly ash(85+10+5)	407.91	47.99	23.9	680.1	400	722	168	3.844
4	OPC+ Kota stone slurry powder + Fly ash (77.5+15+7.5)	371.92	71.98	35.99	680.1	400	722	168	3.844
5	OPC+ Kota stone slurry powder + Fly ash(70+20+10)	335.93	95.98	47.99	680.1	400	722	168	3.844

Table 2: Replacement of OPC by Fly ash& Kota stone slurry powder for M50

S.No.	Mix Name	Cement (Kg)	Kolta stone slurry powder (kg)	Fly ash(Kg)	Coarse Aggregate(Kg)		Fine Aggregate (Kg)	Water (Kg)	Admixture (Kg)
					20mm	10mm			
1	OPC+Kota stone slurry powder + Fly ash (100+0+0)	525.2	0.00	0.00	665.8	391.1	706	168	4.21
2	OPC+ Kota stone slurry powder + Fly ash (92.5+5+2.5)	485.81	26.26	13.13	665.8	391.1	706	168	4.21
3	OPC+ Kota stone slurry powder + Fly ash(85+10+5)	446.42	52.52	26.26	665.8	391.1	706	168	4.21

4	OPC+ Kota stone slurry powder + Fly ash (77.5+15+7.5)	407.03	78.78	39.39	665.8	391.1	706	168	4.21
5	OPC+ Kota stone slurry powder + Fly ash (70+20+10)	367.64	105.04	52.52	665.8	391.1	706	168	4.21

Test on Concrete (Fresh & Hardened State)

Following Test is Adopted for testing of concrete

1. Slump
2. Density
3. Compressive Strength
4. Flexural Strength
5. Spliting Tensile Strength

Result & Analysis

The consequences of test work have been dissected and all mixes/blends in which there were parcel of varieties in aftereffect of various blends. Results have been classified and have likewise been graphically exhibited for subtleties. The varieties had been made with concrete. Supplant couple of level of bond with Fly ash and Kota stone slurry powder which differs from (Fly ash 0% to 10% at interim of 2.5%) and (Kota stone slurry powder 5% to 20 % at interim of 5%) for both cement blends of M45 and M50. Tests had been led for after effect of droop, thickness, compressive quality, flexural quality and part rigidity.

Workability Test Result

Usefulness demonstrates the conduct of the crisp cement during time of blending, taking care of, conveyance and situation at the purpose of arrangement of concrete and after that at time of compaction and completing of the surface. It is estimation for the deformability of the new concrete. Droop of all blends are taken and appeared in arranged structure and graphical structure. Configuration is done based on droop 135mm-138mm and the droop was discovered 135mm for M45 evaluation concrete, 138 for M50 evaluation concrete. Numerous varieties have seen while checking for droop of various cement blends. There are a few organizations and diagrams are given as pursues.

Table 3: Slump on replacement of OPC by Fly ash & Kota stone slurry powder for M45

S.No	Mix (Cement + Kota stone slurry powder + Fly ash)	Slump (mm)
1.	OPC+Kota stone slurry powder+ Fly ash(100+0+0)	135
2.	OPC+ Kota stone slurry powder+ Fly ash (92.5+5+2.5)	138
3.	OPC+ Kota stone slurry powder+ Fly ash (85+10+5)	142
4.	OPC+ Kota stone slurry powder+ Fly ash(77.5+15+7.5)	148
5.	OPC+ Kota stone slurry powder + Fly ash(70+20+10)	154

Table 4: Slump on replacement of OPC by Fly ash& Kota stone slurry powder for M50

S.No	Mix (Cement + Kota stone slurry powder + Fly ash)	Slump (mm)
1.	OPC+Kota stone slurry powder+ Fly ash (100+0+0)	138
2.	OPC+ Kota stone slurry powder+ Fly ash (92.5+5+2.5)	143
3.	OPC+ Kota stone slurry powder+ Fly ash (85+10+5)	152
4.	OPC+ Kota stone slurry powder+ Fly ash (77.5+15+7.5)	154
5.	OPC+ Kota stone slurry powder+ Fly ash (70+20+10)	159

Results of Hardened Concrete

Results of hardened concrete for density test, compressive strength test, flexural strength test and splitting tensile strength test were conducted which are given as under.

Density Test Result

The thickness of example was resolved before testing the example of shape, shaft and chamber and before assurance of thickness of example, surface of example was cleaned and swept with clean cotton cloths. Average weight of Cube, Beam and Cylinder are 8.415Kg (for 7 days) & 8.52 Kg (for 28 days), 12.86Kg (for 28 days) and 39.35 Kg (for 28 days) separately.

Table 5: Density of hardened concrete on replacement ofOPC by Fly ash& Kota stone slurry powder for M45

S.No	Mix(Cement + Kota stone slurry powder+ Fly ash)	Density of Hardened Concrete (Kg/m^3)
		Replacement
1	OPC+Kota stone slurry powder+ Fly ash (100+0+0)	2414
2	OPC+ Kota stone slurry powder+ Fly ash (92.5+5+2.5)	2417
3	OPC+ Kota stone slurry powder+ Fly ash (85+10+5)	2421
4	OPC+ Kota stone slurry powder+ Fly ash (77.5+15+7.5)	2442
5	OPC+ Kota stone slurry powder+ Fly ash (70+20+10)	2444

Table 6: Density of hardened concrete on replacement of OPC by Fly ash& Kota stone slurry powder for M50

S.No	Mix (Cement + Kota stone slurry powder+ Fly ash)	Density of Hardened Concrete (Kg/m^3)
		Replacement
1	OPC+ Kota stone slurry powder+ Fly ash (100+0+0)	2434
2	OPC+ Kota stone slurry powder+ Fly ash (92.5+5+2.5)	2443
3	OPC+ Kota stone slurrypowder+ Fly ash(85+10+5)	2456
4	OPC+ Kota stone slurry powder + Fly ash (77.5+15+7.5)	2462
5	OPC+ Kota stone slurry powder + Fly ash (70+20+10)	2464

Compressive Strength

The compressive quality of Fly fiery remains and Kota stone slurry powder blends was estimated with 3D shape example of size 150mm(length) x 150mm(width) x 150mm(depth).The examples were tried in the wake of restoring for 7 days and 28 days completely submerged in water tank according to IS 516:1959 for technique for tests for quality of cement.

Table 7: 7 & 28 days Compressive strength of cube on replacement of OPC by Fly ash & Kota stone slurry powder for M45

S.No	Mix (Cement + Kota stone slurry powder + Fly ash)	Average For Compressive Strength M-45 (N/mm^2)	
		7 Days	28 Days
1	OPC+Kota stone slurry powder+ Fly ash(100+0+0)	36.39	53.39
2	OPC+ Kota stone slurry powder + Fly ash (92.5+5+2.5)	38.25	55.28
3	OPC+ Kota stone slurry powder + Fly ash (85+10+5)	38.26	56.26

4	OPC+ Kota stone slurry powder + Fly ash (77.5+15+7.5)	37.42	55.31
5	OPC+ Kota stone slurry powder + Fly ash(70+20+10)	36.20	54.73

Table 8 : 7 & 28 days Compressive strength of cube on replacement ofOPC by Fly ash& Kota stone slurry powder for M50

S.No	Mix(Cement + Kota stone slurry powder+ Fly ash)	Average For Compressive Strength M-50 (N/mm^2)	
		7 Days	28 Days
1	OPC+ Kota stone slurry powder + Fly ash (100+0+0)	40.20	58.25
2	OPC+ Kota stone slurry powder + Fly ash (92.5+5+2.5)	42.39	60.98
3	OPC+ Kota stone slurry powder + Fly ash (85+10+5)	43.69	62.85
4	OPC+ Kota stone slurry powder + Fly ash (77.5+15+7.5)	43.32	62.04.
5	OPC+ Kota stone slurry powder + Fly ash(70+20+10)	42.93	62.19

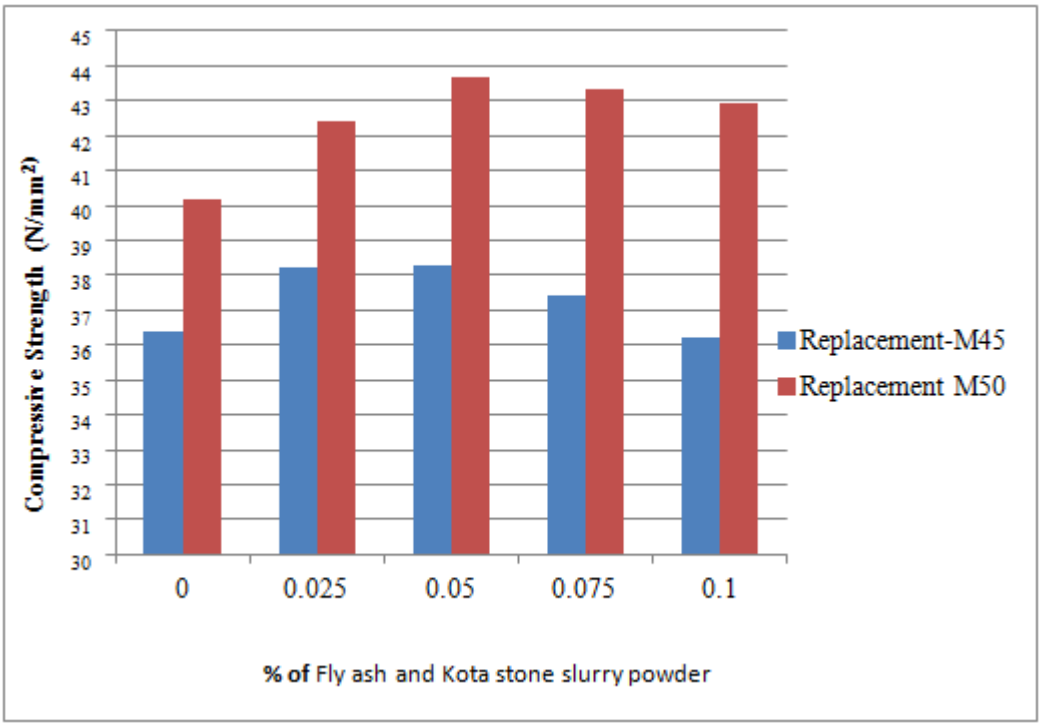

Figure 1: Comparison of Compressive sterngth M45 & M50 in replacement at 7 days

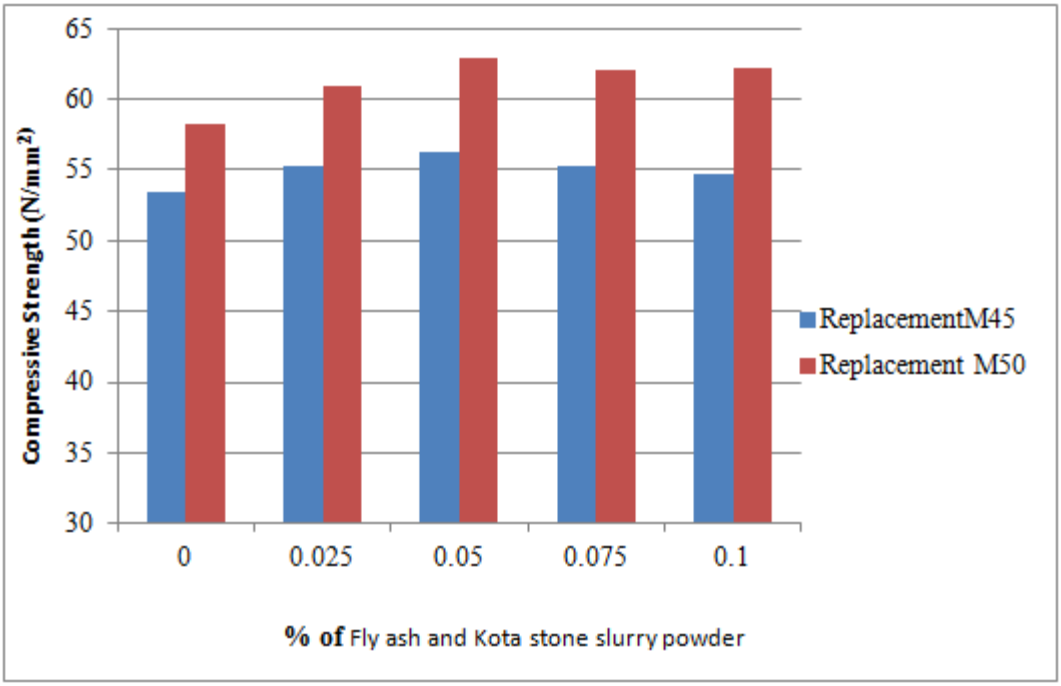

Figure 2: Comparison of Compressive sterngth M45 &M50 in replacementat28 days

Flexuralstrength

The Flexural quality of Fly slag and Kota stone slurry powder blends was estimated with pillar example of size 700mm(length) x 150mm(width) x 150mm(depth).The examples were tried in the wake of relieving for 28 days completely inundated in water tank according to IS 516:1959 for technique for tests for quality of cement. The middle point stacking technique was utilized for this testing.

Table 9 : 7 & 28 days Flexural strength of beam on replacement of OPC by Fly ash&Kota stone slurry powder for M45

S.No	Mix (Cement + Kota stone slurry powder + Fly ash)	Average for Flexural strength M-45 (N/mm^2)
1	OPC+ Kota stone slurry powder + Fly ash(100+0+0)	6.57
2	OPC+ Kota stone slurry powder + Fly ash (92.5+5+2.5)	7.02
3	OPC+ Kota stone slurry powder + Fly ash (85+10+5)	7.13
4	OPC+ Kota stone slurry powder + Fly ash (77.5+15+7.5)	7.01
5	OPC+ Kota stone slurry powder + Fly ash(70+20+10)	6.95

Table 10: 28 day's Flexural strength of beam on replacement of OPC by Fly ash& Kota stone slurry powder for M50

S.No	Mix (Cement + Kota stone slurry powder+ Fly ash)	Average For Flexural Strength M-50 (N/mm^2)
1	OPC+ Kota stone slurry powder + Fly ash (100+0+0)	7.07
2	OPC+ Kota stone slurry powder + Fly ash (92.5+5+2.5)	7.61
3	OPC+ Kota stone slurry powder + Fly ash (85+10+5)	8.05
4	OPC+ Kota stone slurry powder + Fly ash(77.5+15+7.5)	7.64
5	OPC+ Kota stone slurry powder + Fly ash(70+20+10)	7.94

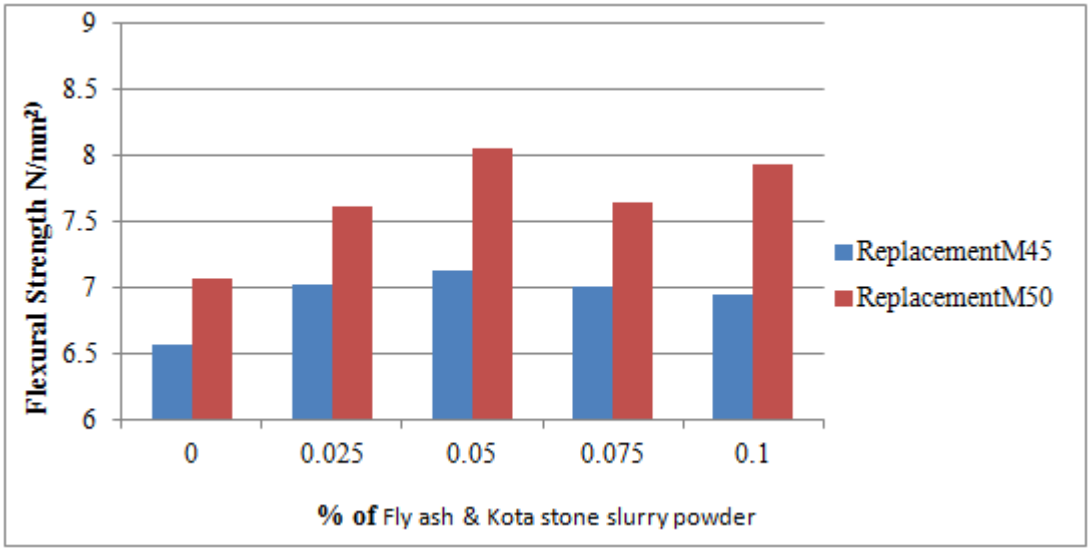

Figure 3: Comparison of Flexural strength M45 & M50 in replacement at 28 days

Splitting tensile strength

The Split elasticity of Fly fiery debris and Kota stone slurry powder blends was estimated with chamber example of size 300mm(length) x 150mm(diameter).The examples were tried in the wake of relieving for 28 days completely submerged in water tank according to IS 5816:1999 for strategy for test part rigidity of cement.

Table 11: 28 days splitting tensile strength of cylinder on replacement of OPC by Fly ash& Kota stone slurry powder for M45

S.No	Mix (Cement + Kota stone slurry powder + Fly ash)	Average for Splitting tensile strength M-45 (N/mm2) 28 days
1	OPC+ Kota stone slurry powder + Fly ash (100+0+0)	4.83
2	OPC+ Kota stone slurry powder + Fly ash (92.5+5+2.5)	5.36
3	OPC+ Kota stone slurry powder + Fly ash(85+10+5)	5.87
4	OPC+ Kota stone slurry powder + Fly ash (77.5+15+7.5)	5.21
5	OPC+ Kota stone slurry powder + Fly ash (70+20+10)	5.05

Table 12 : 28 days Splitting tensile strength of cylinder on replacement of OPC by Fly ash& Kota stone slurry powder for M50

S.No	Mix (Cement + Kota stone slurry powder + Fly ash)	Average For Splitting Tensile strength M-50 (N/mm^2)
1	OPC+ Kota stone slurry powder + Fly ash(100+0+0)	5.31
2	OPC+ Kota stone slurry powder + Fly ash (92.5+5+2.5)	5.89
3	OPC+ Kota stone slurry powder + Fly ash (85+10+5)	6.24
4	OPC+ Kota stone slurry powder + Fly ash (77.5+15+7.5)	6.10
5	OPC+ Kota stone slurry powder + Fly ash (70+20+10)	5.76

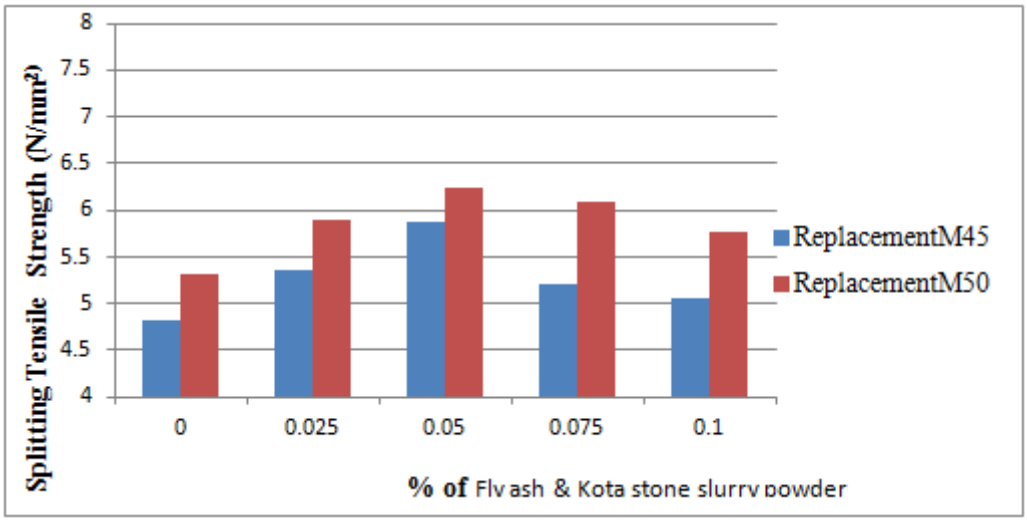

Figure 4: Comparison of Splitting tensile strength M45 & M50 in replacement at 28 days

Conclusion

By evaluating the results of Slump test, Density test, Compressive strength test, Flexural strength test and Splitting tensile strength test, following conclusions have been drawn.

A. Slump& Density

- By replacement of (0% to 10% Fly ash with augmentation of 2.5% and 5% to 20% Kota stone slurry powder slurry with addition of 5%) Fly ash and Kota stone slurry powder into OPC, the droop of the solid blend was step by step expanded up to 10 % substitution of Fly ash and 20% of Kota stone slurry powder for blends M45 and M50 because of low water request and small scale molecule size of Fly ash and Kota stone slurry powder than OPC at starting stage.
- Density of M45 and M50 evaluation cement was higher compare to control blend M45 and M50 grade (when Fly ash was substitution 10% by weight of concrete and Kota stone slurry powder was supplant 20% by weight of bond) .

B. Compressive Strength

- Compressive quality of cement was expanded in blends M45 and M50, when Fly ash and Kota stone slurry powder was supplanting (0% to10% Fly ash with addition of 2.5% and 5% to 20% Kota stone slurry powder with augmentation of 5%) to OPC. Most extreme 7 days compressive quality was seen in M45 grade 38.26 N/mm2 (when Fly ash was supplant 5 % by weight of bond and Kota stone slurry powder was supplant 10 % by weight of concrete) it was 5.14 % more prominent than control blend M45 and M50 grades 42.69 N/mm2 (when Fly ash was supplant 5 % by weight of concrete and Kota stone slurry powder was supplant 10% by weight of bond) it was 6.19 % more noteworthy than control blend M50.
- Higher Compressive strength was found as 56.26N/mm2 in M45 (when Fly ash was supplant 5 % by weight of concrete and Kota stone slurry powder was supplant 10% by weight of bond) and 62.85 N/mm2 in M50 (when Fly ash was supplant 5 % by weight of concrete and Kota stone slurry powder was supplant 10% by weight of bond) on substitution of bond by Fly ash and Kota stone slurry powder.

C. Flexural Strength

- Flexural quality of cement was expanded in blends of M45 and M50, when Fly ash and Kota stone slurry powder was supplanting (0% to 10% Fly ash with addition of 2.5% and 5% to 20% Kota stone slurry powder with augmentation of 5%) to OPC. Most extreme flexural quality was watched M45 grade 7.13 N/mm2 (when Fly ash was supplant 5 % by weight of bond and Kota stone slurry powder was supplant 10% by weight of concrete) it was 8.52 % more noteworthy than control blend M45 and M50 grade 8.05 N/mm2 (when Fly ash was supplant 5 % by weight of bond and Kota stone slurry powder was supplant 10% by weight of concrete) it was 13.86 % more prominent than control blend M50.

D. Splitting Tensile Strength

- Splitting rigidity was expanded in blends of M45 and M50, when Fly ash and Kota stone slurry powder was supplanting to (0% to 10% Fly ash with addition of 2.5% and 5% to 20% Kota stone slurry powder with augmentation of 5%) OPC. Most extreme part elasticity was watched M45 grade 5.87 N/mm2 (when Fly ash was supplant 5 % by weight of bond and Kota stone slurry powder was supplant 10% by weight of concrete) it was 21.53 % more

prominent than control blend M45 and M50 grade 6.24 N/mm2 (when Fly ash was supplant 5% by weight of concrete and Kota stone slurry powder was supplant 10% by weight of concrete) it was 17.51 % more noteworthy than control blend M50.

References

1. Aman Jain and Rohan Majumder, “Strength, Permeability and Carbonation properties of Concrete containing Kota Stone Slurry” International Journal of Advance Research and Innovation Volume 4, Issue 4, PP-735-739, 2016.
2. Sayed Imran Ali, Ranjan Kumar and Mukesh Kumar Yadav, "An Experimental Investigation on Concrete Containing Ground Granulated Blast Furnace Slag and Kota Stone Powder Slurry", International Research Journal of Engineering and Technology (IRJET),Volume: 05, Issue: 04, PP-2282-2284, Apr-2018.
3. Miss Pooja kumari, Er. Mahendra Kumar Singar and Er. Mahendra Saini, "To Improve The Quality Of Mortar in The Construction Field Using Kota Stone Waste Material As Fully Replacement Of Sand", International Journal of Recent Trends in Engineering & Research (IJRTER), Volume 04, Issue 12, PP-30-40, December- 2018.
4. Suraj Singh Shekhawat and Siddharth Sharma, "A Study On Behavior of Concrete By Partial Replacement of Cement With Waste Marble Powder And FLYASH", International Research Journal of Engineering and Technology (IRJET), Volume: 05, Issue: 04, PP-4387-4391, Apr-2018.
5. Rishi and Dr. Vanita Aggarwal, "Effect on Partial Replacement of Fine Aggregate and Cement by Waste Marble Powder/ Granules on Flexural and Split Tensile Strength, Volume 11, Issue 4, Ver. II, PP-110-113, Jul- Aug. 2014.
6. Purvansh B. Shah, "Concrete Mix Design as Per IS Method of Mix Design", International Journal of Science and Research (IJSR), Volume 7 Issue 3, PP-1161-1164, March 2018.
7. Alzboon, K. K. and K. N. Mahasneh, "Effect of using stone cutting waste on the compression strength and slump characteristics of concrete", International Journal of Environmental Science and Engineering, volume-1, Issue-4, PP-167-172, 2009.
8. Yogendra Kumar Meena, Devkinandan Meena, Puneet Chaudhary and Arpita Sharma, "Partial Replacement of Fine Aggregate with Kota Stone Dust & Fly ash in Cement Mortar", 2nd International Conference on new Frontiers of Engineering, Management, Social Science and Humanities, Pune, PP-97-102, 27 May 2018.