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Experimental Investigation on Quarry Dust and Recycled Aggregates in Concrete

J.Vengadesh Marshall Raman[1], V.Gnanadevi[2], V.Anitha[3]

[1] R&D Coordinator, Department of Civil Engineering, Mailam Engineering College, Mailam, Villupuram District, Tamil Nadu 604304, India.

[2,3]Assistant Professor, Adhiparasakthi Engineering College, Melmaruvathur, Tamil Nadu, India

Abstract

Huge quantities of construction and demolition wastes are generated every year in developing countries like India. The main goal of this study is to check the properties of concrete when the recycled aggregate and quarry dust is used as partial replacement of aggregate. The mixes were conventional mix and other mixes were obtained by replacing 10, 20, 30, 40 and 50 percent of the volume of coarse aggregates by recycled aggregates and 20 percent of fine aggregate by quarry dust and water cement ratio (w/c) is taken as 0.45. Test results gives clear picture that the compressive strength of recycled concrete up to 30% coarse aggregate replacement by demolished waste with 20% fine aggregates replacement by quarry dust is the optimum quantity used for construction work.. Optimum quantity for split tensile strength and flexural strength are also been determined.

Key words: Recycled Aggregate (RA), Quarry Dust (QD), Compressive strength, Split tensile strength and flexural strength.

I. INTRODUCTION

Concrete is one of the most widely used construction materials in the world, mainly due to its favorable features such as durability, versatility, satisfactory, compressive strength, cost effectiveness and availability. Now day’s natural raw materials are very scarce and increased cost of natural aggregates forces researchers to find alternatives to both coarse and fine aggregate in concrete. In this rapid industrialized world recycling of construction materials plays an important role. Recycled concrete aggregates may be obtained from construction and demolition waste. Quarry dust obtained from stone quarries poses a serious problem for disposal and by using quarry dust as fine aggregate disposal problem has been reduced and also its abundant availability reduces the cost of construction.

Monish observed that, up to 30% of coarse aggregate replaced by demolished waste gave strength closer to the strength of plain concrete cubes and strength retention is in the range of 86.84-94.74% as compared to conventional concrete. *Murali* arrived at the result that the maximum compressive strength of concrete with and without chemical admixture can be achieved by 30% replacement coarse aggregate by waste aggregate. *Khatib* (2005) concluded that concrete strength decreases when recycled concrete was used and the strength reduction is beyond 40% of replacement. However, no decrease in strength was reported for concrete containing up to 30% coarse recycled concrete aggregates. *Lohani* said that the increase in dust content up to 30% increases compressive strength of concrete, if the dust content is more than 30% the compressive strength decreases gradually. But the compressive strength of quarry dust concrete continues to increase with age for all the percentage of quarry dust contents. *Balamurugan* concluded that concrete acquires maximum increase in compressive strength at 50 % sand replacement. When compared with concrete with only river sand, the amount of increase in strength is 19.18% and 5.21% for M20 and M25 respectively. *Ilangovan* concluded that the replacement of natural sand with Quarry Rock Dust, as full replacement in concrete is possible. However, it is advisable to carry out trial casting with Quarry Rock Dust proposed to be used, in order to arrive at the water content and mix proportion to suit the required workability levels and strength requirement

II. EXPERIMENTAL INVESTIGATON

2.1. Cement

Ordinary Portland cement (OPC 53 grade) is used as the main binder. The physical properties of cement obtained and used are given in Table 1

Table 1 Physical Properties of Cement

Si .No	Properties	Test Results
1	Standard consistency	29%
2	Initial setting time	45min
3	Final setting time	175 min
4	Specific gravity	3.15

2.2. Fine Aggregate and Quarry Dust

Good Quality River sand, free from silt other impurities were used in this study. Sand passing through 4.75 mm has to be used in this experimental work. Quarry dusts are occupied in rest of Thiruvakarai Quarry. The following properties of fine aggregates and Quarry dust are determined as per: 2386-1963, is given in Table 2

Table 2 Properties of Fine Aggregate

Si .No	Properties	Results	
		Sand	Quarry Dust
1	Specific gravity	2.71	2.62
2	Fineness modulus	3.16	3.82
3	Water absorption (%)	1.55	6.49
4	Bulk density (kg/ m^3)	1750	1540

2.3. Coarse Aggregate and Recycled Aggregate

The coarse aggregate passing through 20 mm and retaining 4.75 mm has to be used for experimental work. Recycled aggregate are taken in demolished building near Mailam. The following properties of coarse aggregate and recycled aggregate are determined as per IS: 2386-1963, is given in Table 3

Table 3 Coarse Aggregate and Recycled Aggregate

Si .No	Properties	Results	
		Coarse Aggregate	Recycled Aggregates
1	Specific gravity	2.84	2.54
2	Fineness modulus	9.13	7.9
3	Water absorption (%)	0.5	0.2
4	Bulk density(kg/ $m^{3)}$	1510	1645

III. EXPERIMENTAL PROCEDURE

Table 5 Ingredients for 1m^3 of M25 Grade Concrete

Si.No	Materials	Quantity
1	Cement	438 kg/m^3
2	Water	197 kg/m^3
3	Fine aggregate	809kg/m^3
4	Coarse aggregate	1038 kg/m^3
5	Water/ Cement ratio	0.45

Table 6 Proposed Mix Proportion

RA:QD (%)	Cement kg/m^3	Fine aggregate kg/m^3	Coarse aggregate kg/m^3	Recycled aggregate kg/m^3	Quarry dust kg/m^3
0: 0	438	809.75	1038	0	0
10: 20	438	647.8	934.76	103.86	161.95
20: 20	438	647.8	830.90	207.72	161.95
30: 20	438	647.8	727.04	311.58	161.95
40: 20	438	647.8	623.17	415.45	161.95
50: 20	438	647.8	519.31	519.31	161.95

III. RESULTS AND DISCUSSION

Table 7 Slump Cone Value

S.No	Recycled aggregates: Quarry dust (%)	Slump Value
1	0% RA + 0% QD	110
2	10% RA + 20% QD	105
3	20% RA + 20% QD	99
4	30% RA + 20% QD	92
5	40% RA + 20% QD	89
6	50% RA + 20% QD	83

Chart 1 Slump Cone Value

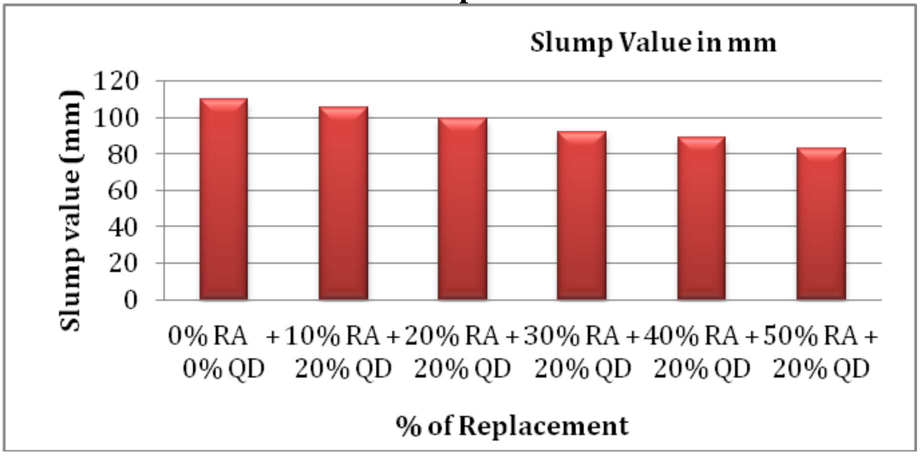


Table 8 Compressive strength of cube in N/mm^2

Si.No	Recycled aggregates: Quarry dust (%)	Compressive Strength N/mm^2		
		3rd day	7th day	28th day
1	0% RA + 0% QD	20.3	37	50.75
2	10% RA + 20% QD	19.6	35.5	49
3	20% RA + 20% QD	18.9	35	47.25
4	30% RA + 20% QD	15.6	32.5	39
5	40% RA + 20% QD	12.8	25.5	32
6	50% RA + 20% QD	8.5	19.5	21.25

Chart 2 Compressive Strength of Cube in N/mm^2

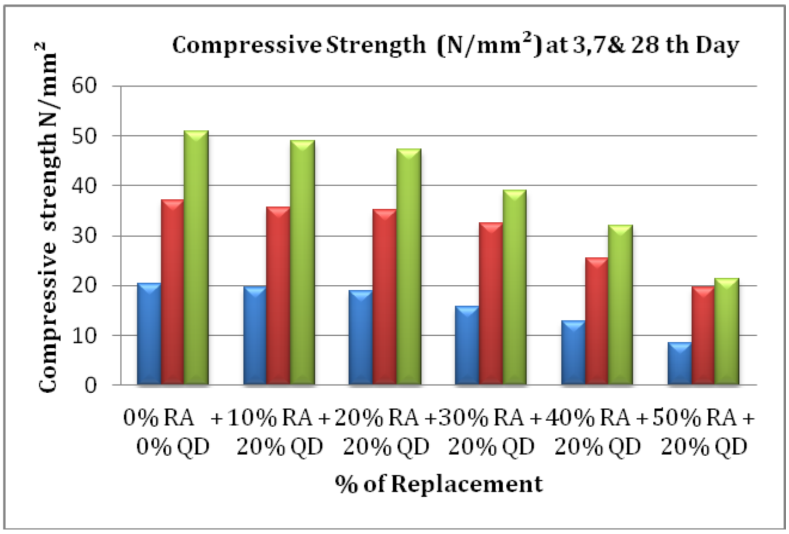


Table 9: Split Tensile Strength of Cylinder in N/mm²

Si.No	Recycled aggregates: Quarry dust (%)	Split tensile strength N/mm² at 28th day
1	0% RA + 0% QD	2.83
2	10% RA + 20% QD	2.75
3	20% RA + 20% QD	2.56
4	30% RA + 20% QD	2.54
5	40% RA + 20% QD	2.12
6	50% RA + 20% QD	2.01

Chart 3 Split Tensile Strength of Cylinder in N/mm²

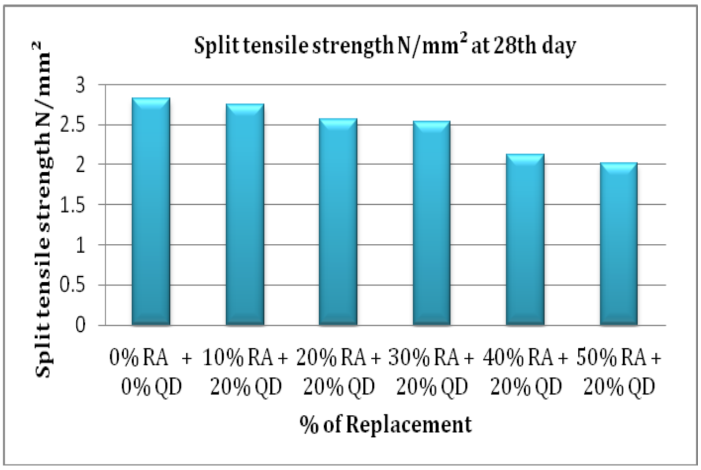
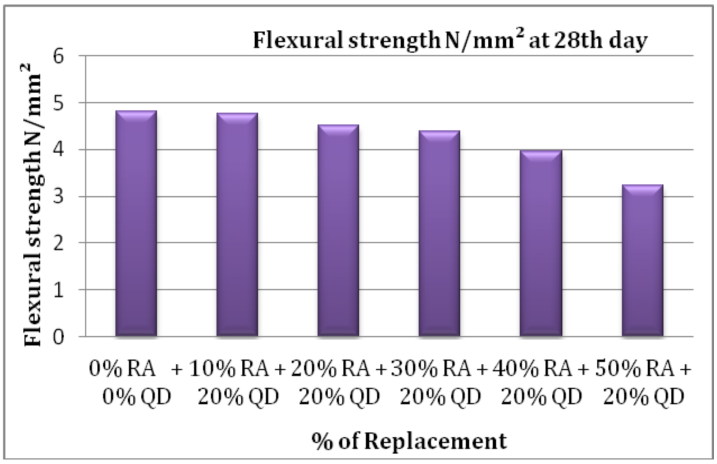


Table 10 Flexural Strength of Prism in N/mm²

Si.No	Recycled aggregates: Quarry dust (%)	Flexural strength N/mm² at 28th day
1	0% RA + 0% QD	4.81
2	10% RA + 20% QD	4.77
3	20% RA + 20% QD	4.51
4	30% RA + 20% QD	4.37
5	40% RA + 20% QD	3.95
6	50% RA + 20% QD	3.23

Chart 4 Flexural Strength of Prism in N/mm^2



V. CONCLUSION

When the Recycled aggregate replaced to Coarse aggregate with varying percentage from 10% to 50% and Quarry dust replaced with river sand of 20 % for all the Mix expect conventional concrete the following results were drawn.

1. The Slump value showed a steep decrease when the RA percentage is increased as shown in Chart -1.
2. With 30% of RA and 20% of QD the compressive strength at the end of 3,7 and 28 days 15.6, 32.5 and 39N/mm2 respectively.
3. The compressive strength at the end of 28 days steadily decreases when the RA percentage is increased. However the compressive strength of M25 concrete at the end of 28 days for 30% replacement of RA and 20% of Quarry dust is 39 N/mm2 as shown in Table -8.
4. The compressive strength showed a steep decrease when the RA percentage is increased as shown in Chart -2.
5. With 30% of RA and 20% of QD the Split tensile strength at the end of 28 days is 2.54N/mm2 respectively.
6. The split tensile strength at the end of 28 days decreases when the RA percentage is increased. However the split tensile strength of M25 concrete at the end of 28 days for 30% of RA and 20% of QD as shown in Table -9.
7. The split tensile strength showed a steep decrease when the RA percentage is increased as shown in Chart -3.
8. With 30% of RA and 20% of QD the Flexural strength at the end of 28 days is 4.37N/mm2 respectively.
9. The Flexural strength at the end of 28 days decreases when the RA percentage is increased. However the Flexural strength of M25 concrete at the end of 28

days for 30% of RA and 20% of QD is 4.37N/mm^2 as shown in Table -10.

10. The Flexural strength showed a steep decrease when the RA percentage is increased as shown in Chart -4.

REFERENCES

[1]. Mirjana Malešev 1, Vlastimir Radonjanin 1 and Snežana Marinković 2, Recycled Concrete As Aggregate For Structural Concrete Production. *Sustainability* 2010, 2, 1204-1225; doi:10.3390/su2051204

[2]. Mohd Monish1, Vikas Srivastava1, V. C. Agarwal1 and Rakesh Kumar2.Utilization of demolished waste as fine aggregate in Concrete. *Journal of Academic and Industrial Research.* Vol. 1(7) December 2012

[3]. Khatib JM. Properties of concrete incorporating fine recycled aggregate. *Cement & Concrete Composites* Research 2005; 35(4):763–9.

[4]. Katz A. Properties of concrete made with recycled aggregate from partially hydrated old concrete. *Cement & Concrete Composites* Research 2003; 33:703–11.

[5]. Dr.P.B.Sakthivel1, C.Ramya2, M.Raja3, An Innovative Method of Replacing River Sand by Quarry Dust Waste In Concrete For Sustainability. *International Journal of Scientific & Engineering Research* Volume 4, Issue 5, May-2013 ISSN 2229-5518

[6]. J. Karthick1, T.Rama2, N.Mani Bharathi3, An Experimental Study on Usage Of Quarry Rock Dust As Partial Replacement for Sand in Concrete.

[7]. G.Balamurugan1, P.Perumal2, Behavior Of Concrete On The Use Of Quarry Dust To Replace Sand – An Experimental Study. *International Journal of Scientific and Research Publications,* Volume 3, Issue 12, December 2013 1 ISSN 2250-3153

[8]. Lohani T.K.1, Padhi M.2, Dash K.P.3, Jena S.4 Optimum utilization of Quarry dust as partial replacement of sand in concrete .*Int. Journal of Applied Sciences and Engineering Research*, Vol. 1, No. 2, 2012 .,ISSN 2277 – 9442

[9]. Anitha Selva Sofia S.D.1, Gayathri R.2, Swathig.3, Prince Arulraj G.4 Experimental Investigation On Quarry Dust Concrete With Chemical Admixture. *International Journal of Latest Research in Science and Technology ISSN* Volume 2,Issue 2 :Page No.91-94, March - April (2013)

[10]. Chandana Sukesh, Katakam Bala Krishna, P.Sri Lakshmi Sai Teja, S.Kanakambara Rao, Partial Replacement Of Sand With Quarry Dust In Concrete. *International Journal of Innovative Technology and Exploring Engineering (IJITEE)* ISSN: 2278-3075, Volume-2, Issue-6, May 2013.

[11]. IS 7320-1974.., specification for concrete slump test apparatus.

[12]. I.S: 456 – 2000, Indian standard Specification for plain and reinforced concrete

– code of practice. (Fourth revision), B.I.S., New Delhi.

[13]. I.S: 2386-1963, Methods of Test for aggregates for concrete - Part 3: Specific gravity, Density, Voids, Absorption and Bulking, Bureau of Indian Standard, New Delhi.

[14]. I.S: 383 – 1970, Indian standard specification for coarse & fine aggregates from natural sources for concrete, B.I.S., New Delhi.

[15]. I.S: 516-1959, Indian Standard Methods of Test for Strength of concrete. Bureau of Indian Standards, New Delhi.

[16]. I.S: 10262 – 1982, Indian standard recommended guidelines for concrete mix Design, B.I.S., New Delhi.

[17]. I.S: 1199-1959, Indian Standard Methods of Sampling and analysis of concrete. Bureau of Indian Standards, New Delhi.