Aggregate Impact of the Country in Concrete Durability, that Works in Normal Environmental Conditions

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Abstract

Production and use of durable concrete in reinforced concrete structures is a necessity in our country. In this article it was treated as affecting the characteristics of aggregates in durable concrete production, when they work in normal environmental conditions . To achieve this goal have produced concrete of class C35 / 45 with aggregate taken in careers mountain and river. The other components are the same in mix design concrete. Water-cement ratio is 0.5 and 0:35 realized. Comparisons are made of the resistance to compression and water penetration. Cubes of concrete had been produced and treated in terms shipyard. There have been comparisons of results and following. Today in Durres, even wider, buildings constructed with durable concrete are very few in now days. Geological studies show that the soil in foundation has low retaining capacity for this city due to high friction angle. This is also one of the other factors that Seismicity of the area is very high, up to level 9 ball of Rihter. The purpose of this article is the production of durable concrete with low permeability of water. The project is constructed in our country and in particular in Durres where groundwater level is higher and the use of space efficiently needs to build parking with underground floor.

Keywords: *Concrete durability, aggregate, permeability of durable concrete, strength concrete*

1. INTRODUCTION

With the use of concrete durability we go further and ask that concrete have much longer life not only to the destruction but their work time or as called "lifetime" or the time before the repair, be much longer. This requires that we seek concrete durability and longevity of the structure reinforced concrete. For this purpose we must consider:

1. To obtain concrete durability in use should distinguish between possible life of concrete as a material to be used in specific environmental conditions and longevity of concrete factual deed therefore be taken into account that concrete properties in the composition of the structure.

2. The water impermeable concrete with a resistance to water penetration under ISO 7031-1994 standard specifications, or otherwise rely on standard EN 206-1 , permeability should be up to 20 to 50 mm.

2. MATERIALS AND METHODOLOGY

Concrete components produced by Albanian standards S EN 206-1: 2003, with resistance class C35 / 45, taken in Fushe Kruje by concrete and Shkodra Vega by Mat River to Dry Stream

2.1 Materials

2.1.1 Cement

The details of the experimental program have been reported in this study. Concrete ingredients produced by the Albanian standard S SH EN 206-1:2003, with resistance class C35/45, were taken in Fushe Kruja from Vega concrete production site. The concrete is produced in SAG concrete plant. Composition of Portland cement, CEM I 42.5 R, from ANTEA, type cement conforming EN 197-1 was used in this study.

Table 2.1.1: Chemical Composition of CEM I 42.5 R TITAN cement

No.	Chemical composition	Units	Test results	Standard limit based on EN 197-1 standard
1	SiO_2 (Min.)	%	18.01	-
2	Fe_2O_3 (Min.)	%	2.69	-
3	Al_2O_3 (Min.)	%	4.58	-
4	MgO (Max.)	%	1.80	5.00%
5	CaO (Min.)	%	61.23	10.00%
6	SO_3 (Max.)	%	2.67	3.50%
7	(Cl) (Max.)	%	-	0.10%
8	I.R (Max.)	%	0.3	5.00%

Table 2.1.2: Physical Properties of CEM I 42.5 R TITAN Cement

No.	Physical characteristics	Units	Test results	EN 197-1 Standard limit
1	Specific surface, Blaine	cm^2/g	3842	± 200
2	Specific density	g/cm^3	-	± 50
3	Standard consistency	%	28	-
4	Initial setting time	min	2h:30min	60
5	Final setting time	min	-	-
6	Loss on ignition (L.O.I)	%	-	≤5%
7	Expansion	mm	0	≤10 mm

Table 2.1.3: Mechanical Properties of CEM I 42.5 R TITAN Cement

No.	Mechanical characteristics	Units	Test results		
			2 Days	28 Days	EN 197-1Standard limits
1	Compressive strength	MPa	26	48	2Days > 20 MPa 28Days ≥ 42.5 dhe ≤ 62.5MPa
2	Flexural strength	MPa			

2.1.2 Aggregates

Coarse and fine aggregates obtained from Mat river Perroi i Thate and Fushe Kruja quarry units have been used for this study. Maximum size of coarse aggregate used is 25 mm and specific gravity of ranging from 2.6 - 2.7 kg/m3 based on standard S SH 509:1987; bulk density 1484 kg/m3 and fine modulus 6.07. For fine aggregates maximum size used is 5 mm and specific gravity of ranging from 2.687 kg/m3 based on standard S SH 509:1987; and fine modulus 2.74.

sitat mm	peshat g	mbetjet %	kalimi %
31.5	0.0	0.00	100.00
25.0	0.0	0.00	100.00
16.0	0.0	0.00	100.00
12.5	0.0	0.00	100.00
8.0	0.0	0.00	100.00
4.0	10.3	0.70	99.30
2.0	391.2	26.70	73.30
1.00	867.3	59.20	40.80
0.50	1082.6	73.90	26.10
0.250	1201.3	82.00	18.00
0.125	1278.9	87.30	12.70
0.075	1322.9	90.30	9.70
Pesha fillestare gr	1465		

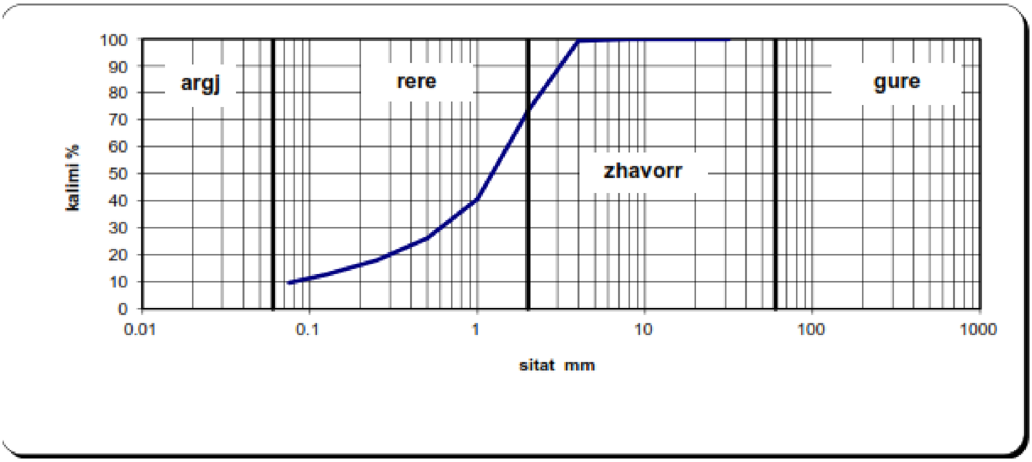

Figure 1: a) Coarse and b) fine aggregates PSD analysis river .

sitat mm	peshat g	mbetjet %	kalimi %
31.5	0.0	0.00	100.00
25.0	0.0	0.00	100.00
16.0	0.0	0.00	100.00
12.5	98.2	1.90	98.10
8.0	1849.4	35.80	64.20
4.0	5104.0	98.80	1.20
2.0	5109.2	98.90	1.10
1.00	5114.3	99.00	1.00
0.50	5119.5	99.10	0.90
0.250	5124.7	99.20	0.80
0.125	5129.8	99.30	0.70
0.075	5135.0	99.40	0.60
Pesha fillestare gr		5166	

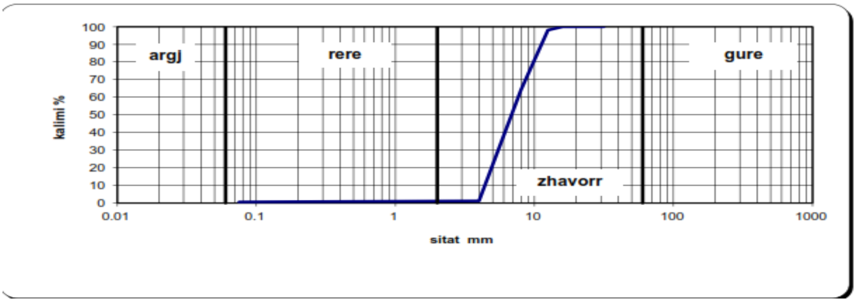

Figure 2: a) Coarse and b) fine aggregates PSD analysis river

sitat mm	peshat g	mbetjet %	kalimi %
31.5	0.0	0.00	100.00
25.0	0.0	0.00	100.00
16.0	0.0	0.00	100.00
12.5	3278.8	39.70	60.30
8.0	7234.9	87.60	12.40
4.0	8217.7	99.50	0.50
2.0	8242.5	99.80	0.20
1.00	8244.1	99.82	0.18
0.50	8246.6	99.85	0.15
0.250	8250.7	99.90	0.10
0.125	8251.6	99.91	0.09
0.075	8254.9	99.95	0.05
Pesha fillestare gr		8259	

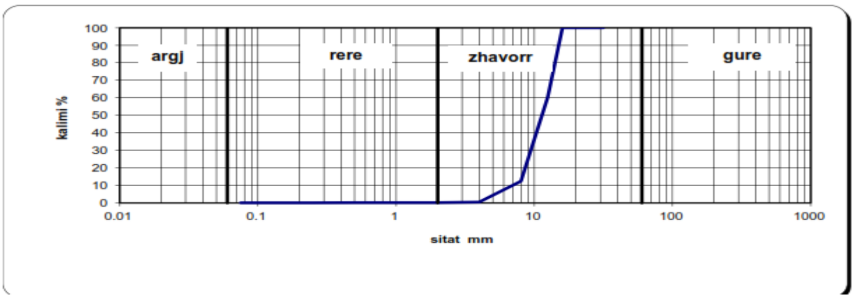

Figure 3: a) Coarse and b) fine aggregates PSD analysis river

Kampioni **Rere e lare lumi 00/08 mm**
Karriera **Prroi I thate**
Test Method : **EN 1097-6-2000(piknometer method)**

Nr	Pershkrimi	njesia	kampioni	
1	Madhesia e agregatit	mm	0-8	0-8
2	Temperatura	ºC	20	20
3	Densiteti I ujit	g/cm3	0.9981	0.9981
4	Pesha e kampionit te thate	g	50.41	50.24
5	Pyknometer No (250 ml)	ml	2	5
6	Pesha e piknometrit	g	150.21	163.67
7	Pesha e piknometrit + uje	g	466.72	480.08
8	Pesha e piknometrit + agregate	g	200.62	213.91
9	Pesha e piknometrit + agregate+ uje	g	498.73	512.21
10	Volumi I piknometrit	cm3	317.11	317.01
11	Pesha e kampionit satured	g	51.31	50.99
12	Absorbimi I agregattit	%	1.785	1.493
13	**Mesatarja e absorbimit**	%	**1.639**	
14	Pesha spesifike per cdo kampion	g/cm3	2.612	2.664
15	**Mesatarja e peshes Specifike**	g/cm3	**2.638**	

Figure 4: a) Coarse and b) fine aggregates PSD analysis river

Kampioni **Granil i thyer lumi 06/12,5 mm**
Karriera **Prroi I thate**
Test Method : **EN 1097-6-2000(piknometer method)**

Nr	Pershkrimi	njesia	kampioni	
1	Madhesia e agregatit	mm	"06-12,5	"06-12,5
2	Temperatura	ºC	20	20
3	Densiteti I ujit	g/cm3	0.9981	0.9981
4	Pesha e kampionit te thate	g	100.12	100.21
5	Pyknometer No (500 ml)	ml	6	7
6	Pesha e piknometrit	g	202.93	208.71
7	Pesha e piknometrit + uje	g	794.71	797.58
8	Pesha e piknometrit + agregate	g	303.05	308.92
9	Pesha e piknometrit + agregate+ uje	g	858.14	861.14
10	Volumi I piknometrit	cm3	592.89	589.98
11	Pesha e kampionit satured	g	100.52	100.63
12	Absorbimi I agregattit	%	0.400	0.419
13	**Mesatarja e absorbimit**	%	**0.409**	
14	Pesha spesifike per cdo kampion	g/cm3	2.699	2.703
15	**Mesatarja e peshes Specifike**	g/cm3	**2.701**	

Figure 5: a) Coarse and b) fine aggregates PSD analysis river

Vega Fushe Kruje

sieve mm	weight g	retained %	passing %
31.5	0.0	0.00	100.00
25	0.0	0.00	100.00
20	0.0	0.00	100.00
16	0.0	0.00	100.00
12.5	0.0	0.00	100.00
8	0.0	0.00	100.00
4	100.0	7.02	92.98
2	583.0	40.91	59.09
1	942.0	66.11	33.89
0.50	1191.0	83.58	16.42
0.250	1337.0	93.82	6.18
0.125	1393.0	97.75	2.25
0.075	1406.0	98.67	1.33
Initial Weight gr		1425	

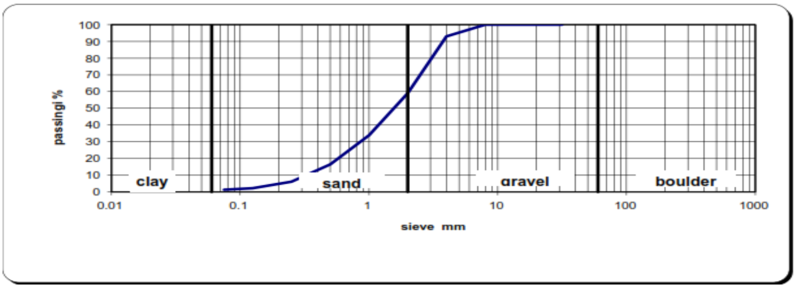

Figure 6: a) Coarse and b) fine aggregates PSD analysis river

Test Method: **EN 933-01**

sieve mm	weight g	retained %	passing %
31.5	0.0	0.00	100.00
25	0.0	0.00	100.00
20	0.0	0.00	100.00
16	0.0	0.00	100.00
12.5	15.0	0.61	99.39
8	1337.0	54.53	45.47
4	2442.0	99.59	0.41
2	2448.0	99.84	0.16
1	2449.0	99.88	0.12
0.50	2450.0	99.92	0.08
0.250	2450.0	99.92	0.08
0.125	2450.0	99.92	0.08
0.075	2450.0	99.92	0.08
Initial Weight gr		2452	

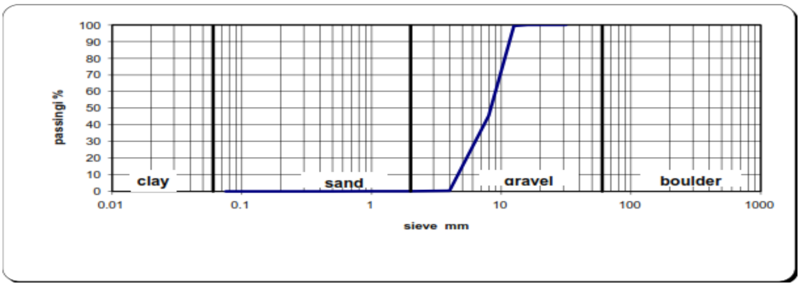

Figure 7: a) Coarse and b) fine aggregates PSD analysis river

sieve mm	weight g	retained %	passing %
31.5	0.0	0.00	100.00
25	117.0	1.71	98.29
20	2124.0	31.02	68.98
16	4466.0	65.22	34.78
12.5	6494.0	94.83	5.17
8	6843.0	99.93	0.07
4	6843.0	99.93	0.07
2	6844.0	99.94	0.06
1	6844.0	99.94	0.06
0.50	6845.0	99.96	0.04
0.250	6845.0	99.96	0.04
0.125	6845.0	99.96	0.04
0.075	6845.0	99.96	0.04
Initial Weight gr		6848	

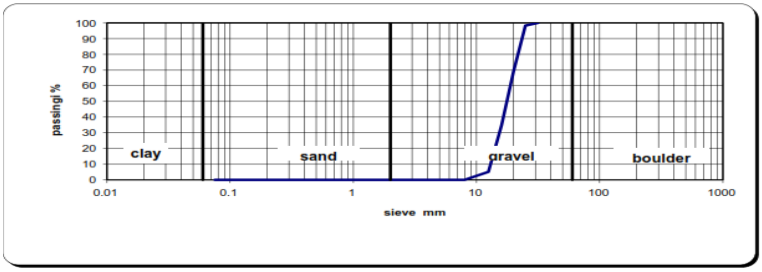

Figure 8: a) Coarse and b) fine aggregates PSD analysis river

Table 2.3.1: The aggregate chemical composition

Chemical composition of aggregates	Chemical composition in [%]			
	CaO	MgO	SiO_2	Fe_2O_3
Vega Fushe Kruje (Mountain)	43.59	4.23	0.18	0.12
Perroi i Thate (Mat river)	5.36	15.98	48.36	5.89

Mount aggregates have been derived from carbonate rocks, with high content of limestone.

River aggregates are with originate volcanic and therefore have a high content of basalt.

2.1.3 Water

Potable tap water available production site was used for mixing and curing of concrete. The water is filtrate based on standard **S Sh** 2751:1987.

Table 2.1.3.1: Chemical analysis of water used in mix design

No.	Characteristics	Units	Test results	Standard limit EN 1008
1	Water resource		Well water	-
2	Colour		Transparent	-
3	Odour		None	-
4	Water density @ 190 C	kg/ l	1.0082	0.9982
5	Total hardness (CaCO3)	mg/l	2.91	-
6	Total dissolved solids at 180 ºC	mg/l	3.82	≤4
7	pH value		7.61	≥4
8	Chloride content Cl-	mg/l	1241	≤ 1000
9	Sulphate content SO4-	mg/l	4996	≤ 2000
10	Salts content	mg/l	0.02	≤ 100

2.1.4 Concrete admixtures

Additives used in this project are; Chryso-Fluid Premia 180(superplasticizer) and in quantities 3 l/m3 concrete. Additives were used to produce concrete class C 35/45 MPa and the result was decreasing the amount of water. The effect of using the lowest amount of water is increasing the durability and resistance of concrete.

2.2 Methodology

2.2.1. Durable concrete mix design

Mix design is a process of selecting suitable ingredients for concrete and determining their proportions which would produce, as economically as possible, a concrete that satisfies the Orion project requirements.
All mix designs data for durable concrete used in our project are represented in Table 2.2.1.1. In present study durable concrete class C35/45 was produced with river raw material. All mix designs are formulated based on specifications of EN 206-1:2003 standard. Date 10.10.2013

Table 2.2.1.1: Mix design of concrete from Kruja mountain

No.	Ingredients	Units/m^3	Quantity
1	Crashed sand 0-04 mm	kg	895
2	Crashed river gravel 5-10 mm	kg	298
3	Crashed river gravel 10-25mm	kg	698
4	Cement CEM I 45.2 R/A-LL	kg	370
5	Additive Chryso-Fluid Premia 180 (superplasticizer) Reduction. 15%; Dosage 0.8 lit/100 kg cement)	lit/m^3	3.32
6	Well water	lit	158
1	w/c ratio	-	0.4
2	Density	kg	2422
3	Temperature of fresh concrete	°c	19
4	Slump		S4

Date 27.11.2013

Table 2.2.1.1: Mix design of concrete from Mat river

No.	Ingredients	Units/m³	Quantity
1	Natural river sand 0-04 mm	kg	915
2	Natural river gravel 5-10 mm	kg	294
3	Natural river gravel 10-25mm	kg	695
4	Cement CEM I 45.2 R/A-LL	kg	380
5	Additive Chryso-Fluid Premia 180 (superplasticizer) Reduction. 15%; Dosage 0.8 lit/100 kg cement)	lit/m³	151
6	Well water	lit	3.56
1	w/c ratio	-	0.4
2	Density	kg	2440
3	Temperature of fresh concrete	°c	19
4	Slump		S4

The compressive strength of concrete is considered as the index of its quality. Therefore the mix designs are generally carried out for a particular compressive strength of concrete with adequate workability so that the fresh concrete can be properly mixed, placed and compacted.

After 28 days period of curing, the specimens were taken out of the curing tank and there were tested besides measuring the fresh properties (workability, air content and concrete temperature); following tests such as permeability of concrete cubes and chlorides contents are measured.

3. RESULTS & TABLES

3.1 Compressive strength of concrete cubes

Compressive strength, of mixes was determined at various ages as per EN 12390-3:1999 and EN 12390-5:1999 are given in table 3.1. Cube Compressive strength at the age 7 and 28 days. After casting the specimens were covered with sheets to minimize the moisture loss from them. Specimens were demoulded after 24-hours and then cured in water at approximately room temperature till testing. Compressive strength tests for cubes were carried out at 28 days. All the specimens were tested in an automated compressive strength machine shown in Figure 3.1:

Table 3.1: Test results obtained from durable concrete produced with Mat river materials

No.	Normal water curing condition (Kruja Mountin crashed aggregates)			Normal water curing condition (Mat River aggregates)		
	Compressive strength	Water depth penetration	day	Compressive strength	Water depth penetration	
1	44.180	22.13	28	43.012	11.2	28
2	40.123	19.25	28	46.338	10.8	28
3	42.156	14.35	28	42.230	16.2	28
4	46.337	19.4	90	47.894	9.2	90
5	47.250	20.5	90	48.154	9.4	90
6	46.510	24.1	90	48.112	7.6	90

Table 3.2: Test results obtained from durable concrete produced with Romanat materials

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3.2 Durability of concrete

The durability of concrete depends largely on the movement of water enters and moves through it. Permeability is a measure of flow of water under pressure in a saturated porous medium while Sorptivity is materials ability to absorb and transmit water through it by capillary suction. The porous structure of concrete is intimately related with its permeability. A low water/cement ratio results in concrete structures which are less permeable because they are characterized by having small pores which are not interconnected. The water penetration under pressure test is a standard test procedure (EN 12390-8).

Figure 3.2.1: Images of water penetration

4. CONCLUSIONS

Production and use of durable concrete is critical to increasing lifespan reinforced concrete structures.
Durable concrete mechanical resistance also depends on the mineralogical composition of component aggregates.
Broken Mountain aggregates, which have a high percentage of limestone, give us a reziztence concrete with almost the same as the aggregate of the river, but having a large water permeability. This is because using a greater quantity of water. They are more economical in the use of cement.
River Aggregates, especially when they have high basalt backgrounds, are more compressed, give us concrete with high resistance, with low water permeability.

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