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Durable Concrete Produced by Local Materials and their Impact in Everyday Life in Albania

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ABSTRACT

Albanian constructions has been involved in lately updated engineering technologies. Use of durable concrete is one of the most important area in which is being pointed.

In this paper I will analyze durability of durable and waterproof concrete, the way it is designed and its conctent, what is the preparation process. All this, will be described according to implementation in some residential buildings in Albania. At the end, will be described how and to what extent the use if these concrete can impact Albanian's everyday life.

The study aims to analyze production and use of waterproof and abrasion resistent concrete produced by mixing materials found in our country with water/cement ratio 0.35 . This creates beautiful concrete with lifespan to the action of car tires in parking areas. All this can be translated in lower economic costs from the traditional way and above all, creates relaxing, creative and healthy environments.

KEYWORDS: *Durable Concrete, Waterproof Concrete, Abrasion Resistance, Water/Cement Ratio, Additive.*

1 INTRODUCTION

The last twenty years Albania has undertaken many projects to build several new objects. Many of them, for example residential buildings, roads, bridges, ect were constructed under contemporary concrete tecnology. Therefore, came out the necessity to study durability and impact of these structures in everyday life.

Concrete is thought as timeless material. Contrary to this, experience have shown that it is a material with limited lifetime because of its porous structure. Therefore it is subject of environmental actions, weather conditions; on the surface and in deepth of its structure.

There can be mentioned different reasons of destruction of concrete structures. Mostly they can be divided into two groups: external actions, which are caused by action of environmental conditions and internal causes, because of quality of concrete production in fresh and hardened statement.

The key element of working life of concrete structures is prohibiting concrete degradation which means lifespan, durability of structures and economic efficiency. Durability is determined as the ability of

the structure to cope and resist environmental actions and other aggressive agents to preserve physical and mecanical functional abilities. The structure must resist the above mentioned destruction causes, to preserve structural, aesthetic and functional use conditions for which it is designed. This is called project duration. Nowadays, internal stability of concrete and stability relating to the environment, is considered a very important parameter.

Concrete structures must also reach some other requirements as reliability, performance and seviceability. Reliability means that the structure should fulfill the given functions in its working life. E.g. if a concrete structure is designed for slab, it is reliable as long as it works like this. Performance of a structure is the combination of durability with functional requirements. Serviceability is viewed as the capacity of the structures to perform the functions for which they are designed and constructed within normal use conditions 1.

The study aims to analyze production and use of waterproof and abrasion resistent concrete produced by mixing local materials. This creates beautiful concrete with lifespan to the action of car tires in parking lot. All this can be translated in lower economic costs from the traditional way and above all, creates relaxing, creative and healthy environments.

2 DURABLE AND WATERPROOF CONCRETE

2.1 Mixture of concrete with quartz and resin for industrial flooring

Mixture of concrete with quartz and resin is used for paving squares, industrial pavements, plateaus and parking areas. It is a great way to combine durability of concrete with aesthetics of texture and color. This concrete is produced by laying quartz separately from concrete casting or simultaneously. Each process is used varying from types of construction. Hereinafter, I will describe some cases in which resin and quartz implementation were appropriately treated for creating the desired effect.

This composition meets the requirements for durability, but also offers extra abilities. Being used in paving areas, this concrete turned out to be very resistent to abrasion. Furthermore, it has the advantage of color specter by creating beautiful aesthetic texture.

Examples below show some residential buildings constructed in Albania, in which is used this type of concrete. One of the most important concern is reaching concrete consistency and creating surfaces which are waterproof and resistent from abrasion. The traditional ways, which did not use quartz or resin in composition, produce rough surfaces, with only one color (gray) and were not as resistent as the one mentioned above.

In this case can be mentioned the ramp of underground parking of a residential object built in Tirana, Albania, Figure.2.1.1

Figure 2.1.1: Ramp of Underground Parking

Durability design of concrete structures - Part 1: Analysis fundamentals, by Radomir Folić, FACTA UNIVERSITATIS Series: Architecture and Civil Engineering Vol. 7, No 1, 2009, pp. 2, 2009

The following, Tab 2.1.1: is an analysis of the mix design concrete used in case of parking.

Tab 2.1.1 Mix design concrete used in the object under study.

MIX DESIGN						
CODE		**R4**				
SITE:		**SAG (Vora, Tirana)**				
CLASS OF CONCRETE		**C 35/45**				
PREPARATION DATE		**11/11/2013**				
EXPOSITION CLASS		**NORMAL**				
STANDARD DEVIATION		**7 Mpa**				
AGGREGATE'S MAX DIMENSIONS		**25mm**				
INGREDINTS OF CONCRETE						
Nr.	***Aggregates of Tirana River, Zall Herr***	***(UNI 9858)***	***VALUES***			
1	**CEMENT**	Type	CEM I			
		Class	42.5 R			
2	**WATER**	From	TITAN			
3	**AGGREGAT (Zall Herr)**	fractured	*Density* (kg/m³)	*Weights* (kg/m³)	Dosage (%)	
	Fractured river sand 0-5 mm	Crashed river	*2.631*	*998*	*52%*	
	Fractured river granulated stone 5-10 mm	Crashed river	*2.681*	*230*	*12%*	
	Fractured river granulated stone 10-25 mm	Crashed river	2.712	691	*36%*	
		UNI 6394	WEIGHT	**1919**	***80%***	
4	**ADDITIV**		**Chryso fluid Premia 180**			
		doz.	1.20%			
		Water reduction	22%			
QUANTITY OF INGREDIENTS						
	Quantities for 1 m^3		Quantities for 0.027 m^3 concrete (Kg)	Factual humidity (%)	Absolute absorption %	Quantity corrected
	Aggregates	Quantities (Kg)				
1	**Fractured river sand 0-5 mm**	998	26.95	5.2%	0.7	28.35
2	**Fractured river granulated stone 5-10 mm**	230	6.21	1.6%	0.3	6.31
3	**Fractured river granulated stone 10-25 mm**	691	18.66	1.0%	0.2	18.84
5	**Cement**	360	9.72			9.72
7	**Water**	125	3.38	1.69	1.20	2.89
8	**Additive** ml/m^3	4.32	116.6			111

9	Total	**2408**				
FRESH CONCRETE PROPERTIES						
Nr	***Attributes***	*Unit*			*Value*	
1	Air temperature during production in lab	ºC			20.0	
2	Water/cement report	Report			**0.35**	
3	Class of consistency	Slump	UNI 9418		20	
9	Density of fresh concrete	kg/m³			**2408**	

Working process for producing concrete with resin or quartz can be realized in two cases:
a) Quartz layer is stewed separately
b) Quartz layer is stewed during precasting concrete

2.1.1 Quartz layer is stewed separately

This process was implemented in a residential object in Tirana, Albania. It was used for concreting plateau (plaque-shape foundation). By using this method, can be obtained a durable surface with texture or desired color. The advantage in this case is that during the construction phase of building industrial layer is not damaged.

Working phases for this process are:
- Concreting the plateau.
- After 3-4 hours, while concrete has been hardened, are disposed slopes quotes required for quartz layer. This layer can vary from min 4 cm. Quotes are posed according to project of internal water drainage in parking floor.
- Make a layer of cement vanish, which is prepared by mixing washed sand with cement. This layer is laid under the above set slopes. So, this layer's composition is sand + cement + pigment.
- Over this layer, is powered quartz dust. In this case quartz can be mixed with color aditive or not. The surface is leveled with trowel. Furthermore, can be used precast formats as brick, wood or stone shape to give the surface different textures.
- After 2-3 hours surface is rubbed with helicopter.
- Finally, after more than 7 days is added rezin over the surface.

2.1.2 Quartz layer is stewed during precasting concrete

This process was implemented in a residential object in Durres, Albania. It was also used for concreting plateau. By using this method, can be obtained a more durable surface because all materials are casted on the spot. Furthermore, the layer of concrete with quartz becames inseparable from the layer of plateau concrete. However, this case can present some problems relating to discharging holes, which should be very good defined before pouring the mixture. Also this method did not provided required floor quotas appropriately.

Working phases for this process are:
- Concrete is powered in plateau 5 cm under definitve quota.
- Slopes quotas are taken out as references for the last layer.
- The last layer is concreted according to the obove quotas.
- Quartz powder is poured over this layer directly.
- After 2-3 hours surface is rubbed with helicopter.
- Finally, after more than 7 days is added rezin over the surface.

Figures below show some examples where were used concrete with quartz and resin. Fig 2 shows a relaxing square nearby a residential building in “Kinostudio” in Tirana, Albania. Materials used for this site are industrial concrete mixed with quartz and coloured additives. Not only the pavement, but also benches are produced by this concrete, creating wood texture.

According to this method, this mixture is cast in situ, powered in precast shapes. As pointed below, surfaces are concepted in stripes with three colors. They are designed by the architect to create aesthetic element by combining stripes with squares and imiting nature colors. The square is not only beautiful but also has reached constructional requirements. Color additives used in this case are inorganic pigments because they do not fade. Use of resin is a eco friendly way, especially for relaxing areas, parks and playground because its porous composition makes the water to drain through and flow into the water table.

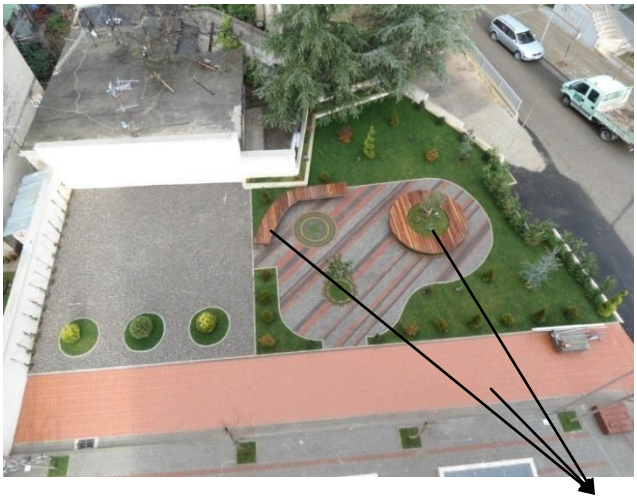

Fig 2.1.2.1: Relaxing Square. Industrial Concrete Layer, with Quartz

Fig.2.1.2.2 -5 show another example of using concrete with rezin and quartz in parkings. The areas below are part of another residential building in Tirana, Albania. The surface obtained in this case is non slip to fulfil appropriate movement of cars. As we can see from photos, the surface is very clean, solvent free, anti dust and healthy for inhabtants.

Figure 2.1.2.2: Parking area

Figure 2.1.2.3: Parking area

Figure 2.1.2.4: Parking area

Figure 2.1.2.5: Parking area

2.2 Mixture of concrete with penetron additive

Use of concrete with penetron additive have been proven to be very effective. It is mostly used for waterproofing of underground walls, foundations, swimming pools, above level concrete constructions ect. This effect is achieved by chemical reactions which happen by combining concrete with penetron. Penetron reacts with by-products of cement and generates cristalline formation throughout the structure. Hence, concrete becomes waterproof and is protected from deterioration because of difficult environmental conditions.

The following Tab 2.2.1 is an analysis of the mix design concrete used in case of parking.

Tab 2.2.1 Mix design concrete used in the object under study, with penetron

MIX DESIGN					
CODE		**R4**			
SITE:		**SAG (Vora, Tirana)**			
CLASS OF CONCRETE		**C 35/45**			
PREPARATION DATE		**11/11/2013**			
EXPOSITION CLASS		**NORMAL**			
STANDART DEVIATION		**7 Mpa**			
AGGREGATE'S MAX DIMENSIONS		**25mm**			
INGREDINTS OF CONCRETE					
Nr.	***Aggregates of Milot from river Mat***	***(UNI 9858)***	***VALUES***		
1	**CEMENT**	Type	CEM I		
		Class	42.5 R		
2	**WATER**	From	TITAN		
3	**AGGREGATES (Milot)**	Granulated	*Density* (kg/m³)	*Weights* (kg/m³)	Dosage (%)
	Fractured river sand 0-5 mm	River	*2.631*	*998*	*52%*
	Fractured river granulated stone 5-10 mm	River	*2.681*	*230*	*12%*
	Fractured river granulated stone 10-25 mm	River	2.712	691	*36%*
		UNI 6394	PESHA	**1919**	***80%***

4	**ADDITIV**		**Penetron Admix**			
		doz.	1.0%			
		Water reduction	28%			
QUANTITY OF INGREDIENTS						
	Quantities for 1 m^3		Quantities for 0.027 m^3 concrete (Kg)	Factual humidity (%)	Absolut absorption %	Amount of correction
	Aggregates	Quantities (Kg)				
1	**Fractured river sand 0-5 mm**	998	26.95	5.2%	0.7	28.35
2	**Fractured river granulated stone 5-10 mm**	230	6.21	1.6%	0.3	6.31
3	**Fractured river granulated stone 10-25 mm**	691	18.66	1.0%	0.2	18.84
5	**Cement**	360	9.72			9.72
7	**Water**	125	3.38	1.69	1.20	2.89
8	**Additive** ml/m^3	4.32	116.6			111
9	Total	**2408**				
FRESH CONCRETE PROPERTIES						
Nr	***Attributes***	*Unit*			*Value*	
1	Air temperature during production in lab	°C			20.0	
2	Water/cement raport	Raport			**0.35**	
3	Class of consistency	Slump	UNI 9418		20	
9	Density of fresh concrete	kg/m^3			**2408**	

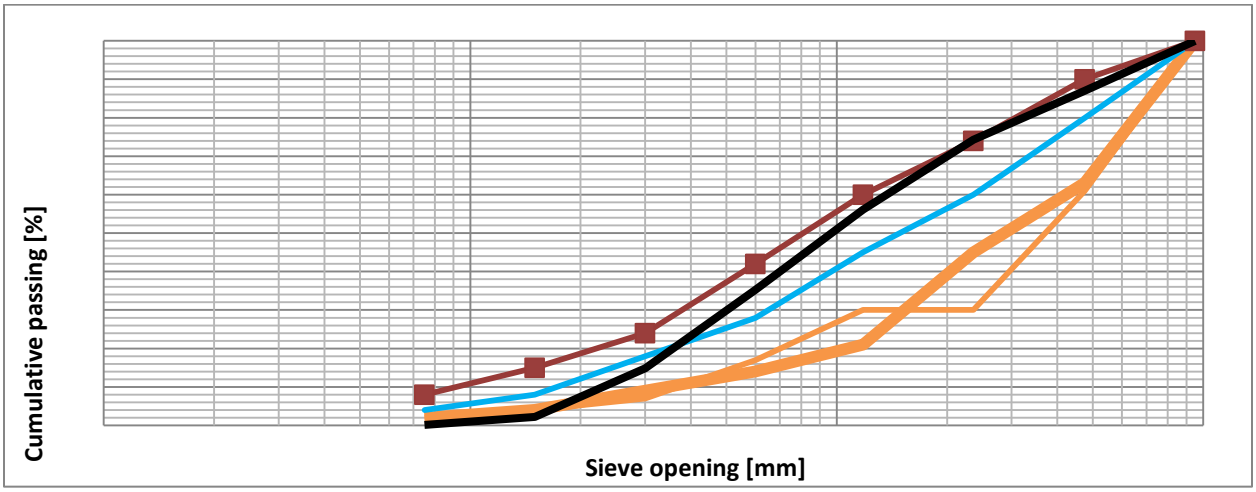

Figure 2.2.1: Reference curve DIN ISO 1045 Grain maximal diameter = 25 mm

The advanteges of using this concrete is that additive becomes part of the concrete creating a strong and durable structure. It is waterproof, and very resistent to hydrostatic pressure and chemical and climatic aggressions. It is also permanent, healthy for inhibitants (non toxic), economically efficient (less expensive than traditional method) and time efficient (reduces construction period).

This concrete was used in platea of another residential building in Durres, Albania. As Durres is a sea side city, was necessary to be used additives to concrete because of the extra amount of underground water. Concrete was produced by using river materials from Milot, Albania and water-cement raport 0.4. By mixing this cement with pentron additive was obtained waterproof concrete. This design is also very resistent to friction forces. Nowadays, this is one of the only buildings where were applied this method. Penetron must be added at the time of batching and temepratures should be not lower than 4 °C.

Working phases for this process are:

- Concrete was prepared before coming in situ, " SAG" . Concrete is produsedby mixing cement type CEM I (class 42.5 R) with water, rugged river sand 0-5 mm (52%), granulated river stone 0-5 mm (12%), granulated river stone 10-25 mm (36%) and aditiv penetron admix (1.0 %); (fig 7, 8).

Figure 7: Granulated river stone 10-25 mm

Figure 8: Granulated river stone 0-5 mm

- Concrete was powered in plateau 5 cm under definitve quota.
- Slopes quotas were taken out as references for the last layer.
- The last layer was concreted according to the obove quotas. In this case we can add color pigment if we want to give additional color range to the surface.
- Quartz powderwas poured over this layer directly.
- Surface was done simple leveling with trowel.
- After 2-3 hours surface was rubbed with helicopter.

2.3 Test Result

The Mat (Milot) river and Erzen(Zall Herr) river materials were used for production of durable concrete. Specimens of concrete with 150mm * 150mm * 150mm dimensions are treated in normal environment. Compressive strength, water depth penetration are measured after 90 days curing age.

The test results are represented in Tab. 2.3.1 below:

Table 2.3.1 Test results obtained from durable concrete produced with river materials

No.	Normal water curing condition (River crashed aggregates Milot)		Normal water curing condition (River crashed aggregates Zall Her)	
	Compressive strength(Mpa)	Water depth penetration (mm)	Compressive strength(Mpa)	Water depth penetration(mm)
1	47.56	13.6	46.12	14.8
2	48.23	13.5	47.13	14.3
3	48.25	13.5	47.28	14.8
4	49.00	13.2	45.23	13.8
5	49.06	13.2	49.00	15.2
6	50.02	13.0	48.09	15.0

The minimal depth pernetration acording EN 209-1:2003 is 20mm, so the concrete that we produced is a durable concrete.

3 IMPACT OF DURABLE AND WATERPROOF CONCRETE IN EVERYDAY LIFE IN ALBANIA

Concrete is a widely used material in Albania, not only for residential buildings but also for industrial manufacturing buildigns (especially during 1950-1990).

Many advantages can be mentioned for using concrete in these constructions.

Firstly, Albania is is part of Jonic-Adriatic sizmologic zone and as such is very vulnerable from eathquakes. Using durable concrete, can increase building structures durability, making new structures stronger, more solid and lengthen the life of structure.

Secondly, production of waterproof and durable concrete cultivates understanding of concrete production companies, to produce concrete that guarantee Albanian and Europian laws.

Thirdly, concrete is a material thet does not burn. Hence, it is very suitable in construction because prevents the spread of fire in building makung people's lifes safer. Added durability of concrete can make structures very resistent from eathquakes, floods blasts etc.

Fourthly, waterproof and durable concrete can create beautiful aesthetic surfaces with various textures, colors and shapes. This concrete can imitate natural materials like stone, wood, tiles by combining and making this special desing. Architectural facades can creaet a variety of shapes and graphics by this.

Fifthly, waterproof and durable concrete is eco-friendly because it is made of nalural materials and minimise impact on the environment. Also has good sound insulation improving quality of life and work.

Sixthly, waterproof and durable concrete is healthy because they does not emitt chemicals in interior environment and indoor air quality is very good. They are the best choise for termal comfort optimizing benfits of solar gain and reducing fuel consumption for heating.

Seventh, this concrete is economic efficient because of its durability. Also, it can be produced and used locally redusing investment and utilization costs. By using in residential buildings we improve energy efficincy, lower the emission of CO2 and other harmful substances and cooling and heating costs. Furthermore, these constructions require low mantainance offering good and comfort livable buildings.

4 CONCLUSIONS

Durable concrete with local materials should be widely used in Albanian constructions. Being part of a very vulnerable country in terms of earthquakes and flood, this concrete offers added durability, resistance, longer life cicle, waterproof maretials. The foregoing results have shown that use of waterproof and durable concrete is a sustainable solution from economic, social and political point of view.

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