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PROJECTING THE MIXTURES FOR MAKING THE HIGH QUALITY CONCRETE

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Abstract. *This work the projecting the mixture for making the high quality concrete to be of use for making the beams stressing by bending moment has been.*
For geffing high quality concrete the same granulomtreic continuos curves except the mixture No.11 and No. 12 which are this continual (without the fraction off 4-8 and off 8-16) where mostly used.
As the components off the concrete where be used the cement" Beočin" PC 45 B the cement" Novi Popovac PC 15 Z 45 B the hydraulic bond "Virolit the cement" Usje PC 45 B the separate aggregate" Moravac ",the limestone and the basalt crushed rock the flying ashes and the supreplastificator ZP and SPk 989.
The breakage of the cubes went along the aggregate (mixture No.7) and along the cement paste.
The mixture with the addition of flying aches in this case has not produced the expected result.
The Regulation BAB '87 article 21 about the high quality concrete says
"The concrete above MB 60 are special concretes that can be used only for special purposess ".
In order to get better proof to find the best way to get high quality concrete experimental research should be made by varying the quantity of concrete, the quantity of flying aches or silicate dust i.e. water concrete factor plastificators as well as the well of producing the concrete.

1. INTRODUCTION

In order to carry on the experimental research of bending the high quality concrete beam carruerssuitable for the longlasting load. It was necessary in present conditions with our materials, first to project concrete mixtures which will quarantee the realisation of the

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very strong concrete MB > 60.

The research programe is devined into two phases:

- The projecting of the concrete mixture and getting high quality concrete and
- Testing the high quality concrete beam carriers suftening the transversal forces up to the point of breaking down under the long lasting pressure.

For that purpose a lot of testing had been done on the concrete cubes, made mostly with the same granulometric curve and the variation of the quality and quantity of hidraulic bonds ”Virolit" and the sort and the quality portland cement of "Beo~in", portland cement of "Novi Popovac", portland cement of "Usje", watercement ratio and as an addition superplastificator and flying ashes.

The experimental researches to get high quality concrete and done in the laboratories tor concrete of the construction firm "Građevinar", Niš 1991/1992 and to be continued 1996/97.

In this phase of research it was decided upon the optimal mixtures (the granulometric curve) the increment rate of the hardness of the concrete was measurd the modulus of the elasticity and the ddiagram of (the dilation) tension of the concrete.

2. THE PROJECTING THE CONCRETE MIXTURE

It is were known that in the proces of projecting the concrete mixture, the aggregate (granulate) as its essential component presents the largestpart of its volumen. The concrete mixture consist of the large and small grains of the agreg ate.

Fine aggregate greatly affects the ratio among the components in the mixture because his specific surface is very large. It is also well known that each grain should tend to be coated by cement paste.

The granular structure of fine aggregate affects greatly not only the features of the fresh (now) concrete but those of the hard (old) as well. Building in of the concrete inercases it fine sand consist of the grains that pass trough the sieve of 0,125-0,25 mm the crude aggregate is very large and the maximal diameter of the grain affects the building in if the concrete and the quantity of cement and aggregate in it. By defining the maximal grain of the crude aggregate and stating the granulating curve with the minimum quantity of fine sand it is possible.

To provide the wanted capacity of the concrete to build in. As it as known the granulation curve of the aggregate appropriate to make the concrete is defined by our standards.

3. THE HARDNEES OF THE CONCRETE UNDER PRESSURE

The testingof the concrete under pressure has been done on the concrete cubes (15cm side) 1, 3 and 8 days old 7, 14, 28 or 3, 7, 14, 28 and the hardness is given in tables calculated and estimated for norming cubes with sides 20 cm.

The hardness of the concrete depends the geometry and size of the sample and the conditions of treatment. The samples of l5 x l5 x l5 cm are treated till the testing day in this concrete example 28 days at most at the temperature of $20 \pm 3\ ^{0}C$ and they were exposed to short lasting loading until the break down. It is well known that the handress

of the concrete produced on the building site is less thann that of the one produced in the laboratory mostly because of the tretment conditions. The hardness of the concrete under long lasting pressure is also less than the firmness of the concrete under short lasting pressure bacause microfractures produced in time are conneted in such a way as to bring up the breakage of the material.

On the basis of the performed tests the fallowing can be concluded:

- The breakage of the most of the concrete cubes went along the cement plaster;
- The breakage of mixtures No.7 went along the aggregate because in this case the aggregate was the limiting factor for producing the higher hardness of the concrete.

For these reasons the mixture No.6 was done with the bazalt aggregate from Preševo surroundings (fractions of 16 to 31.5 mm) and with somewhat larger quantity of "Virolit" (Ljubuški near Mostar) 450 kg/m^3 as it can be seen in the table No.6 the hardness of the concrete under pressure is somewhat less than that of the concrete got by mixture 7. This is probably bacause the bazalt aggregate had not been washed but only watered.

The mixtures 11. 12. 13 are made as fallows: the mixture No.11 only with "Moravac" and only with 3 fractions and 500 kg/m^3 cement "Usje" PC 45S.

Table 1.

Oldage of the concrete	7 days	14 days	28 days
The hardness off the concrete under pressure Mpa	49,56 49,08 50,00	49,78 54,15 57,03	57,37 55,08 55,54
Middle hardness	49,55	53.66	56,00

Table 2.

Oldage of the concrete	7 days	14 days	28 days
The hardness off the concrete under pressure MPa	48,64 42,99 46,35	54,61 56,90 56,90	58,74 59,19 59,65
Middle hardness	45,00	56,14	59,19

The mixture No.1 is made with portland cement in quantity 420 kg/m^3, the aggregate "Moravac" of the fraction maxd=32 mm. The temperatture of the water 18^{0}C, of the air 23°C.

The mixture No.2 is made with portland cement in quantity 420 kg/m3, the aggregate "Moravac" with addition 8% l.p. relation to the weight of the agregate for fraction 0-4 mm which participated with 25%. The temepature of the is 18 ^{0}C, of the air 23 ^{0}C.

Table 3.

Oldage of the concrete	7 days	14 days	28 days
The hardness of the concrete under pressure MPa	56,90 55,00 55,00	61,96 61,49 58,70	67,00 64,70 64,71
Middle hardness	56,63	60,72	65,47

Table 4.

Oldage of the concrete	1 days	3 days	28 days
The hardness of the concrete under pressure MPa	23,17 23,17 23,40	42,68 42,68 41,76	60,12 61,50 58,74
Middle Hardness	23,25	42,37	60,12

The mixture No.3 is made with portland cement PC 15z45B in quantiy 420 kg/m^3 the aggregate "Moravac", with the addition of 8% of l.p. for the fraction 0-4 in the quantity of 25% and differenctly form the previous mixture, with the addition of 3%

superplastificator Zp. The temperatture of the water is 18^0C, of the air 24^0C.

The mixture No.4 is made with portland cement PC45 form Beocin in quantity 500 kg/m^3, the aggregate "Moravac" of the fractio: 0-4 with 32%, 8-16 with 17%, 16-32 with 33%, wc factor 0,377. The temperature of the water 16 ^{0}C, of the air 20 ^{0}C and of the concrete 21 ^{0}C.

Table 5.

Oldage of the concrete	1 day	3 days	28 days
The hardness of the concrete under pressure MPa	18,35 18,35 19,27	35,79 36,72 36,72	49,56 49,56 50,02
Middle hardness	18,66	36,41	49,71

Table 6.

Oldage of the concrete	1 day	3 days	30 days
The hardness of the concrete under pressure Mpa	28,91 27,99 29,37	60,12 60,57 50,48	82,61 78,04 91,74
Middle hardness	28,76	57,06	84,13

The mixture No.5 is made with portland cement PC 45 form Beocin in quantity 420 kg/m^3 the aggregate "Moravac" of the fraction ratio: 0-4 32%, 4-8 with 17%, 8-16 with 17%, 16-32 with 33%, wc factor 0,416. The temperatture of the water 18 ^{0}C, of the air 22 ^{0}C and of the concrete 21 ^{0}C.

The mixture No.6 is made with "Virolit" in quantity 450 kg/m^3, the aggregate "Moravac" and ba-zalt of the fraction ratio: 0-4 with 33%, 4-8 with 17%, 8-16 with 17%, 16-32 with 33%, wc factor 0,353. The temperatture of the water 16 ^{0}C, of the air 20 ^{0}C and of the concrete 21 ^{0}C.

Table 7.

Oldage of the concrete	1 day	3 days	28 days
The hardness of the concrete under pressure Mpa	36,72 35,79 39,01	65,17 66,09 68,80	88,20 96,84 95,91
Middle hardness	37,17	66,69	93,65

Table 8.

Oldage of the concrete	7 days	14 days	28 days
The hardness of the concrete under pressure Mpa	80,77 80,30	77,61 79,85	88,11 90,40
Middle hardness	80,54	78,73	89,40

The mixture No.7 is made with "Viorlit" in quantity 400 kg/m^3, the aggregate "Moravac" of the fraction ratio: 0-4 with 33%, 4-8 with 17%, 8-16 with 17%, 16-32 with 33%, wc factor 0,298. The temperatture of the water 18 ^{0}C, of the air 18 ^{0}C, of the air 18 ^{0}C and of the concrete 20 ^{0}C.

Table 9.

Oldage of the concrete	7 days	14 days	28 days
The hardness of the concrete under pressure Mpa	67,93 67,93	67,93 73,48	77,06 73,48
Middle hardness	67,93	73,48	75,27

Table 10.

Oldage of the concrete	7 days	14 days	28 days
The hardness of the concrete under pressure Mpa	81,23 81,68	86,30 84,89	82,61 85,33
Middle hardess	81,48	85,60	83,97

The mixture No.8 is made with 35% and ratio 0-4, 25% 4-8 the limestone, 40% 8-16 the limestone, portland cement PC 45 B form Beocin in quntity 450 kg/m^3, wc factor 0,25 plastificator Reobit SPK 989 4%. The temperatture of the water 20 ^{0}C, of the air 25 ^{0}C and of the concrete 29 ^{0}C.

The mixture No.9 is made with 35% sand ratio 0-4, 25% 4-8 the limestone, 40% 8-16 the limestone, portland cement PC 45 B from beocin in quantity 450 kg/m^3, wc factor 0,29, plastifikator Reobit SPK 989 2%. The tempetture of the water 18 ^{0}C, of the air 22 ^{0}C and of the concrete 26 ^{0}C.

The mixture No.10 is made with 35% "Moravac", 25% 4-8 limestone, 40% 8-16 the limestone portland cement PC 45 B from beocin in quantity 450 kg/m^3, wc factor 0,25, plastifikator reobit SPK 989 2%. The temperature of the water 20 ^{0}C, of the air 25 ^{0}C and of the concrete 27 ^{0}C.

Table 11.

Oldage of the concrete	7 days	14 days	28 days
The hardness of the concrete under presure Mpa	58,70 57,83	63,80 60,54	64,67 67,93
Middle hardness	58,27	62,17	66,30

Table 12.

Oldage of the concrete	7 days	14 days	28 days
The hardness of the concrete under presure Mpa	62,39 61,96	61,09 64,67	67,50 67,93
Middle hardness	62,18	62,88	67,71

The mixture No.11 is made with 40% "Moravac" 0-4, 25% "Moravac" 8-16, 35% "Moravac" 16-31,5, portland cement Pc 45 B from Usje in quantity 500 kg/m^3, wc factor 0,32, plastifikator Zps 4%. The temperature of the water 21 ^{0}C, of the air 28 ^{0}C and of the concrete 31 ^{0}C.

The mixture No.12 is made with 30% "Moravac" 0-4, 25% "moravac" 4-8, 45% "Moravac" 16-31,5, portland cement PC 45 S form Usje in quantity 500 kg/m^3, wc factor 0,32, plastifikator Zps 4%. The temperatture of the water 20 ^{0}C, of the air 23 ^{0}C and of the concrete 28 ^{0}C.

Table 13.

Oldage of the concrete	7 days	14 days	28 days
The hardness of the concrete under presure Mpa	63,37 64,67	72,50 67,93	76,63 73,48
Middle hardness	64,02	70,21	75,06

Table 14.

Oldage of the concrete	7 days	14 days	28 days
The hardness of the concrete under presure Mpa	75,76 80,22	78,48 80,22	87,65 86,27
Middle hardness	77,99	79,35	86,96

The mixture No.13 is made with 35% "Moravac" 0-4, 25% "Moravac" 4-8, 40% "moravac" 8-16, portland cement Pc 45 S form Usje in quantity 500 kg/m^3, wc factor 0,333, plastifikator Reobet SPK 989 4%. The temperatture of the water 22 ^{0}C, of the air 29 ^{0}C and of the concrete 30 ^{0}C.

The mixture No.14 is made with 35% "Moravac" 0-4, 25% "Moravac" 4-8, 40%

tucanik 8-16, portland cement Pc 45 B form Beocin in qunatity 500 kg/m^3, wc factor 0,294, plastifikator Reobet SPK 989 4%. The temperatture of the water 20 ^{0}C, of the air 26 ^{0}C and of the concrete 29 ^{0}C.

The mixture 12 is made with 4 fractions and 500 kg/m3 cement "Usje" PS 45 S and plastificators "Reobet" SPK 989 4%.

As it can be seen from these tables the gredtest firmness under pressure with cement "Usje" is got bu the mixture 13, 75,06 MPa.

The mixture No.8,9,10 and 14 are made with the "Moravac" sand 0-4 and the linestone aggregate of 4-8, 8-16 mm from Presevo surroundings. In this mixture only the water cement solution and the quntity have been varied. The greatest hardness under presure with "Beocin" cement is got by the mixture No.14 Fak = 86,96 MPa made with 3 fractions 500 kg/m^3 cement WC=0,294, 4% plastification "Reobet" SPK 989.

As it as shown in the table the least hardness under pressure is got with the plastifications of 2% Fak = 75,27 MPa.

4. CONCLUSION

In the concrete cubes made from different cements ("Novi Popovac", "Beocin", "Virolit", "Usje") with 3 or 4 fractions and crushed aggregate the plane direction of breakage went throught the cement stone.

For the concrete cubes made from "Virolit" and aggregate "Moravac" the plane direction went along the aggregate. By this mixture the greatest hardness under pressure is got. fak-93, 65 MPa by Beocin cement is realised the greatest hardness under pressure fak-86,996 MPa.

This leads to a conclusion that the structure make MB 100 can be got by the sand "Moravac" and crushed aggregate from the graundings near the river Glocka near Surdulica.

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PROJEKTOVANJE MEŠAVINA ZA IZRADU VISOKOKVALITETNOG BETONA

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U radu je analizirano projektovanje mešavina za dobijanje visokokvalitetnog betona koji bi se koristio za izradu armirano betonskih nosača napregnutih momentom savijanja.

Za dobijanje visokokvalitetnog betona korišćene su uglavnom, kontinualne granulometrijske krive sa izuzetkom mešavina br.11, br.12 koje su diskontinualne (bez frakcija od 4-8 mm. i 8-16 mm).

Kao komponente betona korišćeni su: cement "Beočin" RS 45 V, cement "Novi Popovac" RS 15 Z 45 V, hidrauličko vezivo "Virolit", cemet "Usje" RS 45 V, separisani agregat "Moravac", krečnjački i bazaltni tucanik, leteći pepeo i superplastifikator ZP i SPK 989. Lom kocki išao je po agregatu (mešavina 7) i preko cementnog maltera.

Mešavina sa dodatkom letećeg pepela u našem slučaju nije dala očekivane rezultate.

Pravilnik BAB 87, član 21 o visokokvalitetnim betonima kaže: "Betoni iznad MB 60 su specijalni betoni koji se mogu upotrebiti samo u posebne svrhe ".

Da bi se izveli čvršći dokazi o tome, kako najcelishodnije doći do visokokvalitetnog betona, treba nastaviti eksperimentalna istraživanja sa variranjem: količine cementa, količine letećeg pepela ili silikatne prašine, odnosno vodo-cementnog faktora, plastifikatora kao i načina spravljanja betona.