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THE FUTURE CONCRETE: SELF COMPACTING CONCRETE

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ABSTRACT

Thepaperpresents thecharacteristics of theself-compactingconcretes, theiradvantages anddisadvantageswhentheyareusedinbuildings.Duetoitsproperties andcomposition,the self-compacting concrete is described here as beingoneof thefuture friendlyenvironmentalmaterialforbuildings.Testsconcerningtoobtaining aself- compactingconcrete,together withthespecificfreshconcreteproperties tests,are described.

***Keywords*: -Durability;environmentalfriendlymaterials;flyash; Self-compactingconcretes; sustainability**

1. GENERAL CONSIDERATION ABOUT SELF-COMPACTING CONCRETE

I.INTRODUCTION

Theconcreteistheman-made materialwhichhasthevastestutilization worldwide.Thisfactleadsto importantproblemsregardingits designand preparation tofinallyobtainaneconomiccostoftheproductonshortandlong time periods.Thematerial hastobealso“friendlywiththeenvironment”during itsfabrication processandalsoitsaestheticalappearancewhenitisusedinthe structures. Itssuccessisdueto:

a)Itsrawmaterialsthathavealargespreading intotheworld;

b)Thepricesofrawmaterialsthatarelow;

c)Theproperties and theperformancesoftheconcretethatconfersit a largescaleofapplication.

Concrete’s performances havecontinuouslyriseinordertoaccomplish the societyneeds.Manystudieshavebeen madeconcerningthe useofaddition. And super–plasticizersin theconcretefor passingthe frontierofminimumwater contentforagoodworkabilityofaconcrete. Asaresultofthis,high performanceconcretesdevelopedhavinga superiordurability.

Self-compactingconcrete(SCC)isaninnovative concretethatdoesnot requiresvibrationforplacingandcompaction. Itisabletoflowunderitsown weight,completelyfillingformworkandachievingfullcompaction,eveninthe presenceofcongestedreinforcement. Thehardenedconcreteisdense, homogeneous andhasthesamemechanicalpropertiesanddurabilityas traditionalvibratedconcrete.

SCChasmanyadvantagessuchasthefollowings:

a)Fromthecontractorspointofviewcostlylaboroperationsareavoided improvingtheefficiencyofthebuildingsite;

b)Theconcreteworkersavoidpokervibrationwhichisahugebenefit fortheirworkingenvironment;

c)Whenvibrationisomittedfromcastingoperations theworkers experiencealessstrenuousworkwithsignificantly lessnoiseandvibration exposure;

d) SCC is believedto increasethe durabilityrelativelyto vibrated concrete(thisisduetothelackofdamage totheinternalstructure, whichis normallyassociatedwithvibration.

e) Faster construction.

f) Reduction in site manpower.

g) Easier placing.

h) Uniform and complete consolidation.

i) Better surface finishing.

j) Improved durability.

k) Increased bond strength.

l) Greater freedom in design.

m) Reduced noise levels, due to absence of vibrations, and

n) Safe working environment.

1.2Developmentof Self Compacting Concrete

TheSCCconceptwasintroduced intoscientificworldinJapanin1986 byProfessorHajimeOkamurafromTokyoUniversity. Thefirstprototypewas developed in1988byK.OzawafromTokyoUniversityasaresponsetothe growing problems associated withconcrete durabilityandthehighdemand for skilledworkers.

InEuropeitwasprobably firstusedincivilworksfortransportation networks inSweden,inthemiddleof1990’s.TheECfundedamulti-national, industryleadprojectSCC1997-2000 andsincethenSCChasfoundincreasing useinall Europeancountries.

SCCwasfirstdeveloped sothatdurabilityofconcretestructurescanbe improved.Sincethen,variousinvestigations havebeencarriedoutandthe concretehasbeenusedinpracticalstructures inJapanandEurope,mainlyby largeconstructioncompanies.Investigations forestablishingarationalmix- designmethodandself-compact abilitytestingmethodshavebeencarriedout fromtheviewpointofmakingitastandardconcrete.Recommendationsand manualsforself-compactingconcretewerealsowritten.

Tomakedurableconcretestructures, sufficientcompaction byskilled workersisrequired.However, thegradualreductioninthenumberofskilled workersinconstruction industryhasledtoasimilarreductioninthequalityof construction work.Onesolutionfortheachievement ofdurableconcrete structures,independentofthequalityofconstructionwork,istheuseofthe SCC,whichcanbecompactedintoeverycornerofaformwork,purelyby meansofitsownweightandwithouttheneedofvibratingcompaction (Fig.1)

InJapan,intheyear1988,SCCemergedonthesceneandithasbeen thesubjectofnumerousinvestigations inordertoadaptittomodernconcrete production.

Atthesametimetheproducersofadditiveshavedevelopedmore andmoresophisticatedplasticizersandstabilizerstailor-madefortheprecast andtheready-mixindustry.

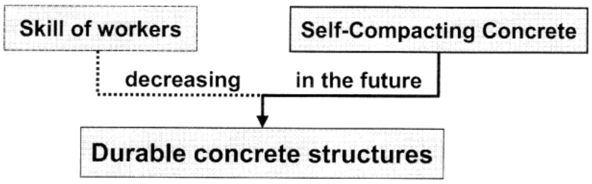

Fig.1–NecessityofSelf-CompactingConcrete

Forlast20years,theproblemofthedurabilityofconcretestructures wasamajortopicofinterest. SCCisaconcretewhichflowstoavirtually uniformlevelundertheinfluenceofgravitywithoutsegregation,duringwhich itde-aeratesandcompletelyfillstheformwork andthespacesbetweenthe reinforcement[2].Itisahigh-performanceconcretewith thespecialpropertyof thefreshconcreteof"self-compacting". Aswithotherhigh-performance concretes(*e.g*.high-strength concrete,acid-resistantconcrete)thespecial properties oftheseconcretes, whichdifferfromnormalconcretes,areachieved onlybysystematicoptimization bothoftheindividualconstituents andofthe composition. TheflowabilityandmixstabilityoftheSCCaredetermined primarilybytheinteractions betweenthepowder(cementandadditionswitha particlediameter< 0.125mm),waterandplasticizer.Thegradationofthe individualsizegroupsintheoverallgradingcurvealsoaffectsthepropertyof theconcreteinthesenseofnotbeingblockedby thereinforcement.

It has been found that, in contrast with vibrated concrete, the workabilitypropertiesrequiredforself-compaction cannotbemaintained relativelyeasilyoverafairlylongperiod.Fluctuations intheworkabilityof vibratedconcretecanbelargelyoffsetbytheintensityofvibration applied duringplacement, butthisisnotpossiblewithSCC.Theeffectsofproduction andtransport ontheworkabilityproperties ofSCCmusttherefore betakeninto accountintheinitialtesting.

II. SELF-COMPACTINGCONCRETECOMPOSITION

Thebasiccomponents for themixcomposition of SCCarethesameas usedinconventionalconcrete. Inordertoobtaintherequestedpropertiesof freshconcreteforSCCahigherproportionofultrafinematerialsandchemicaladmixtures(inparticularlyaneffe ctivesuper plasticizerand viscosity-modifying agent)arenecessarytobeintroduced.Ordinary andapproved

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fillermaterialsare:limestonepowder,quartzite powderandrecycling industrial wastelikeflyash,blastfurnaceslagandsilica fume.

AtypicalmixdesignofSCCincomparisonwithconventionalconcrete isshownin Fig.2

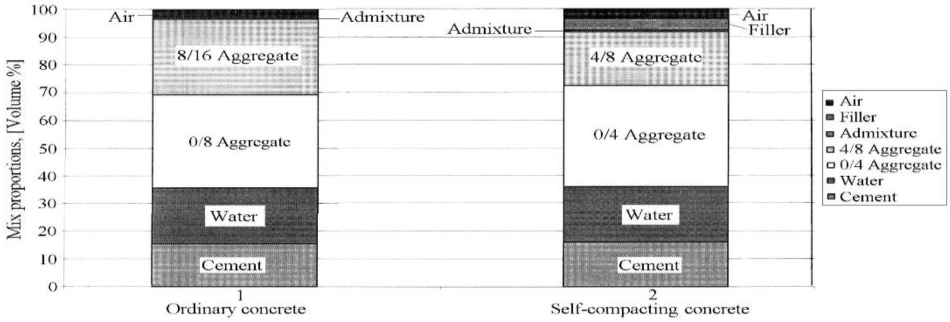

Fig. 2 –Mixcomposition ofSCC incomparison with normal vibrated concrete

“TheEuropeanGuidelinesforSelf- CompactingConcrete”,elaborated inMay2004,defineSCCandmanyofthetechnical termsusedtodescribe its propertiesanduse.Theyalso provideinformationonstandardsrelatedto testing andtoassociatedconstituentmaterialsusedintheproductionofSCC. Therequirements from“TheEuropeanGuidelinesforSelf-Compacting Concrete”forfreshself-compactingconcreteshallbemeasuredbymeansof thefollowingtests(forcharacteristic):

a) Slump- flow and test (for flow ability) (fig.3)

Fig. 3 – Slump-flowtest

b)*V*-funneltest(forviscosity)(Fig.4)

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Fig. 4 – *V*-funnel test.

c)*L*-boxtestfor(passingability)(Fig.5);

Fig. 5 – *L*-boxtest

III. EXPERIMENTALRESEARCHCONCERNINGTHE OBTAININGASELF – COMPACTING CONCRETE

ThecompositionoftheSCCestablishedbytheauthorsofthispaper wasdoneduringaresearch programovertwoyearsinaCEEX–research- developmentprojecttitled:“InnovativeSolutionofOptimization oftheSelf- CompactingConcrete’sMicrostructure forPerformantRealizationofPrecast ConcreteElements”[3].Experimental testsfollowedthepurposeofobtaining somerecipesforSCCthatcanbesuccessfully usedinprecastelementsand structures.Theparameterstakenintoaccountmainlyreferstotheconcretes composition.Table1presentsthefinalcompositionthatwasestablishedfora competitiveself-compactingconcrete.

Table1

Composition		Self-Compacting Concrete
Cement CEM I 42.5R, [kg/m^3]		477.2
Silicafume, [kg/m^3]		53.5
Fly ash, [kg/m^3]		53.5
Fine aggregate [kg/m^3]	0/4mmriver	987.3
Coarseaggregate [kg/m^3]	4/8mmcrushed	526.5
Superplastifiant, [kg/m^3]	GLENIUM ACE 30	7.2 (1.5% [illegible])
Water, [kg/m^3]		198.8
W/C		0.416
Total,[kg]		2,304

FreshconcretecharacteristicsarepresentedinTable2.

Table2

Characteristic			Self -compacting Concrete
Volumetricmass, [kg/m^3]			2,304
	Limits		
	Slump,[mm]	600…800	680
	L-box,h_1/h_2	0.8...1	8.3/9= 0.92
	V-funnel,[sec.]	6…12	12

Thesamples werestriked after48handkeptinwaterfor7days.Then, untiltesthavebeendone,thesamples wereplacedonagrilloverawatertank. Theobtainedhardenedconcreteproperties (Table3)forself-compacting concreteprovethatitcanberefferedto,asSCCintheconcreteresistanceclass C50/60.

Table3

Characteristic	Self-Compacting Concrete
Volumemass,[kg/m^3]	2,305 2,317/2,311
Compression strength oncubes, [N/mm^2]	63.11 64.89/64.00
Compression strength on prisms [N/mm^2]	52.0
Bending tensilestrength [N/mm^2]	8.3
Modulus of elasticity, [KN/mm^2]	47.5

Theobtainedresultsareinaccordancewithsimilartestspresentedin literature.

IV.CONCLUSIONS

1.Flyashcanreplaceasignificantpartofthenecessaryfillerwhen usedintoa self-compactingconcretecomposition.

2.Theeliminationofvibratingequipmentimprovestheenvironment Protectionnearconstructionandprecastsiteswhereconcreteisbeingplaced, reducingtheexposureofworkerstonoiseandvibration.

3.SCCisfavorably suitableespecially inhighlyreinforcedconcrete memberslikebridgedecksorabutments, tunnelliningsortubingsegments, whereitisdifficulttovibratetheconcrete, orevenfornormalengineering structures.

4.Theimprovedconstructionpracticeandperformance,combinedwith thehealthandsafetybenefits,makeSCCaveryattractive solutionforboth precastconcreteandcivilengineeringconstruction.Basedonthesefactsitcan beconcludedthatSCCwillhavea brightfuture.

5. SCC could be developed without using VMA as was done in the study.

6. Labour cost can be minimized.

7. Overall strength of RCC structures is increased.

8. Workability parameters for initial mix design of SCC which need to be assessed can be summarized as filling ability, passing ability and segregation resistance

9. It is evident that the properties of SCC in hardened state are similar to those of conventional concrete.

10. Different studies show that high strengths and adequate durability can be obtained using SCC.

Better internal frost resistance was exhibited by SCC as compared to normal concrete.

11. Permeation properties like water sorptivity and oxygen permeability was lower for SCC. Also, SCC had higher resistance against chloride penetration, frost freeze thaw and scaling, due to the increased dispersion of cement and filler, and a denser ITZ compared to conventional concrete.

REFRENCES

1.Ouchi-KochiM.,Hibino-NagaokaM.,Development,ApplicationsandInvestigations of Self-CompactingConcrete. Japan,2000.

2.KordtsS.,GrubeH.,ControllingtheWorkabilityPropertiesofSelf-Compacting ConcreteUsed asReady-MixedConcrete. Düsseldorf,Germany, 2006.

3.* * *TheEuropean GuidelinesforSelf-CompactingConcrete. EN 12350-1:1999E.

4.OkamuraH.,OuchiM.,Self-CompactingConcrete.J.ofAdv.Technol.,JapanCon-Crete Inst.,**1**, 1, 5-15 (2003).

5.* * * InnovativeSolutionsforOptimizationofMicrostructureCompositionofSelf-Compacting Concrete for PerformantRealization of Precast Concrete Elements.CNCSIS/MEC, Contractno96/2006, partnershipwithICECON Bucharest,“Politehnica”Univ.ofTimişoara,Techn.Univ.ofConstruction Bucharest,Univ. ofCluj-Napoca.

6. EFNARC - *Specification and Guidelines for self-compacting concrete,* February 2002.

7. Bapat, S.G., Kulkarni, S.B., Bandekar, K.S., *Using SCC in nuclear power plants- Laboratory and mockup trials at Kaiga*, The Indian Concrete Journal 78(6) 2004, 51 - 57.

8. Rols, S., Ambroise, J., Pera, J.,*Effects of different viscosity agents on the properties of self-leveling concrete*. Cement and Concrete Research 29(2) 1999, 261-266.

9. Sari, M., Prat, E., Labastire, J.-F., *High strength self-compacting concrete Original solutions associating organic and inorganic admixtures*. Cement and Concrete Research 29(6)1999, 813-818.

10. Lachemi, M., Hossain, K.M.A., Lambros, V., Bouzoubaa, N., *Development of cost-effective selfconsolidating concrete incorporating fly ash, slag cement, or viscosity-modifying admixtures*. ACI Materials Journal 100(5) 2003, 419-425.

11. Lachemi, M., Hossain, K.M.A., Lambros, V., Nkinamubanzi, P.C., Bouzoubaa, N., *Performance of new viscosity modifying admixtures in enhancing the rheological properties of cement paste*. Cement and Concrete Research 34(2) 2004, 189-193.

12. Pei, M., Wang, D., Hu, X., Xu, D., *Synthesis of sodium sulfanilate-phenol-formaldehyde condensate and its application as a super plasticizer in concrete*. Cement and Concrete Research 30(11) 2000, 1841-1845.

13. Vengala, J., Ranganath, R.V., *Mixture proportioning procedures for self-compacting concrete*. The Indian Concrete Journal 78(8) 2004, 13-21.