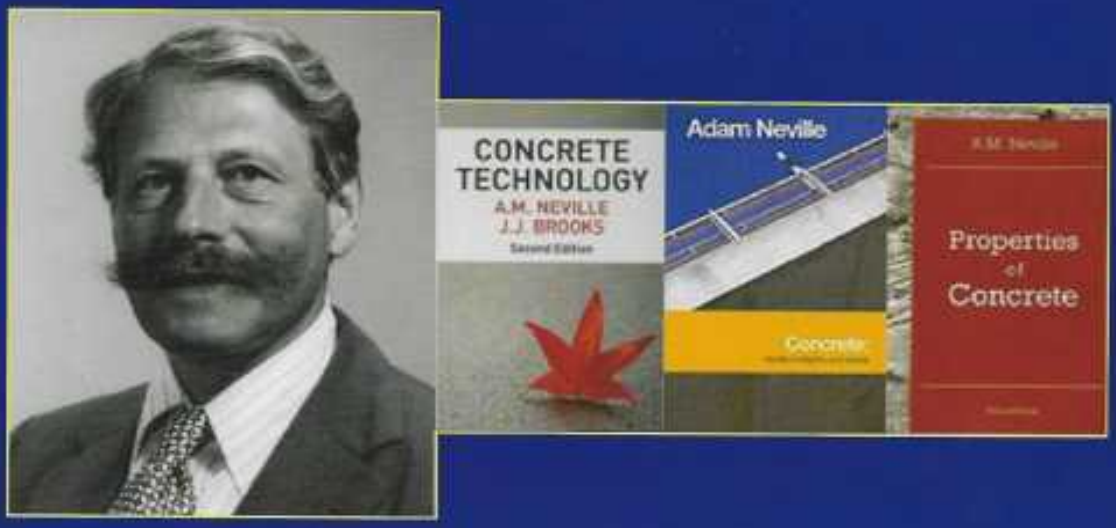
STRUCTURAL ENGINEERING

QUARTERLY JOURNAL OF
INDIAN SOCIETY
OF
STRUCTURAL ENGINEERS

ISSE

VOLUME 18-4

Oct-Nov.-Dec. 2016



GEM 10: Dr. Adam Neville-World's foremost expert in concrete
(See Page 3)

"Report on ISSE function: Wind loading on tall buildings".
(See page 13)

Precast Ferro- cement housing
(See page 14)

LET US BUILD A STRONG STRUCTURE OF INDIAN SOCIETY

STRUCTURAL ENGINEERS

QUARTERLY JOURNAL

INDIAN SOCIETY OF STRUCTURAL ENGINEERS

ISSE

VOLUME 18-4, OCT.-NOV.-DEC. 2016

Head Office : C/O S.G. Dharmadhikari, 24, Pandit Niwas, 3rd Floor, S. K. Bole Road, Dadar (W.), Mumbai 400 028 • Tel. : 91-22 24314423 / 24221015 • E-mail : issemumbai@gmail.com • Website : www.isse.org.in

Regd. Office : The Maharashtra Executor & Trustee Co. Ltd., Bank of Maharashtra, Gadkari Chowk, Gokhale Road (N.), Dadar (W.), Mumbai 400 028.

Charity Commissioner Reg. No. E-17940, Mumbai Donations are exempted from Income Tax under 80-G

Contents

Editor : Hemant Vadalkar

Green Concrete & Concrete Testing Laboratory On Wheels

Paresh Unnarkar

As a RCC Consultant, we always check design, detailed engineering and check the reinforcement at site as per our designs & drawings but we generally never give importance to the raw materials, grade of concrete, mixing of concrete and placing of concrete, which plays a vital role.

In Mumbai, site supervisor is responsible for the quality & grade of concrete.

In our Vasai Virar region, RCC consultant is responsible for the quality, grade of concrete, safety, serviceability and durability of concrete. From last 4 to 5 years our building are going for high rise i.e. up to Ground + 23 Upper Storey (up to 70 m height). As we are going for high rise, higher grade of concrete such M30, M35 & M40 is required.

We all are aware that, to produce 1 Ton of Ordinary Portland Cement approx.. 1 Ton of Carbon dioxide is emitted in environment. India is the second largest producer of cement after China. Concrete is the second largest consumed product by human being after water. From this, we can understand how much Carbon dioxide is emitted and carbon footprint is increasing.

As an Engineer I (Paresh Unnarkar) & Mr. Jitendra Hatkar, decided to produce the Concrete which will be "Most ***ECOLOGICAL, ECONOMICAL, WORKABLE & DURABLE CONCRETE***".

We decided to check the concrete of following combination-

a) Ordinary Portland Cement – 100%
b) Portland Pozzolona Cement – 100%
c) OPC (75%) + Fly Ash (25%)
d) OPC (50%) + GGBS (50%)
e) OPC (90%) + Silica Fume (10%)

Along with-

a) Workability (Slump)
b) Strength
c) Durability – Rapid Chloride Penetration Test, Water Penetration Test & Water Permeability Test.
d) Chemical Analysis of Concrete – 10%PH, Chloride Content, Water Soluble Sulphate.

Global Lab, Mira Road (NABL accredited) agreed to do the tests and accepted to do the mix and all tests in our presence only.

In Vasai Virar region, for mixing of concrete 1 bag Cement Mixer is used and the mix is nominal mix for M20 (1:1.5:3). The slump is around 160 to 200 mm. No admixture is used in concrete to reduce water and to increase slump. The quality of Natural sand is also not good.

Mix of concrete is done for the nominal mix of M20(1:1.5:3) for all above said combinations.

Testing Result of Fine Aggregate – Natural Sand

Sieve	Weight Retained (gm)	%of Weight Retained	Cum % Retained	Cum % Passing	IS 383 Limits
10 mm	35	3.5	3.5	96.5	100
4.75 mm	70	7	10.5	89.5	90-100
2.36 mm	106	10.6	21.1	78.9	75-100
1.18 mm	187	18.7	39.8	60.2	55-90
600 Micron	178	17.8	57.6	42.4	35-59
300 Micron	286	28.6	86.2	13.8	8-30
150 Micron	121	12.1	98.3	1.7	0-10
Pan	17	1.7	100	0	0-10
Total	1000			Zone	II

Fineness Modulus = 3.17
Specific Gravity = 2.65
DLBD (Kg/Lit) = 1.63
Water Absorption (%) = 3.74

Testing Result of Coarse Aggregate 10 mm

Sieve	Weight Retained (gm)	%of Weight Retained	Cum % Retained	Cum % Passing	IS 383 Limits
16 mm	0	0	0	100	100
12.5 mm	0	0	0	100	100
10 mm	47	2.4	2.4	97.7	85-100
4.75 mm	1499	75	77.3	22.7	0-20
2.36 mm	372	18.6	95.9	4.1	0-5
Pan	82	4.1	100	0	
Total	2000				

Fineness Modulus = 5.59 DLBD (Kg/Lit) = 1.55
Specific Gravity = 2.84 Water Absorption (%) = 1.55

Testing Result of Coarse Aggregate 20 mm

Sieve	Weight Retained (gm)	%of Weight Retained	Cum % Retained	Cum % Passing	IS 383 Limits
25 mm	0	0	0	100	100
20 mm	12	0.6	0.6	99.4	85-100
10 mm	1942	97.1	97.7	2.3	0-20
4.75 mm	42	2.1	99.8	0.2	0-5
Pan	4	0.2	100	0	
Total	2000				

Fineness Modulus = 6.97 DLBD (Kg/Lit) = 1.62
Specific Gravity = 2.85 Water Absorption (%) = 1.29

Concrete Mix Design – for Ordinary Portland Cement

Gradients	Type of Material	Source of Material	Average Specific Gravity	Water Absorption	Material in Kg/Cum
Cement	OPC- 53 Grade	Ultratech	3.15		390
Fine Aggregate	Natural Sand	----	2.65	3.74	714
Coarse Aggregate	10 mm Aggregate	----	2.84	1.55	466
Coarse Aggregate	20 mm Aggregate	----	2.85	1.29	618
Water	Potable Water	----	----	----	233

Concrete Mix Design – for Portland Pozzolona Cement

Gradients	Type of Material	Source of Material	Average Specific Gravity	Water Absorption	Material in Kg/Cum
Cement	PPC	Ultratech	2.92		390
Fine Aggregate	Natural Sand	----	2.65	3.74	703
Coarse Aggregate	10 mm Aggregate	----	2.84	1.55	459
Coarse Aggregate	20 mm Aggregate	----	2.85	1.29	609
Water	Potable Water	----	----	----	233

Concrete Mix Design – for Ordinary Portland Cement + Fly Ash

Gradients	Type of Material	Source of Material	Average Specific Gravity	Water Absorption	Material in Kg/Cum
Cement	OPC-53 Grade	Ultratech	3.15		300
Mineral Admixture	Fly Ash	Pozzoash	2.20		90
Fine Aggregate	Natural Sand	----	2.65	3.74	701
Coarse Aggregate	10 mm Aggregate	----	2.84	1.55	457
Coarse Aggregate	20 mm Aggregate	----	2.85	1.29	607
Water	Potable Water	----	----	----	232

Concrete Mix Design – for Ordinary Portland Cement + Ground Granulated Blast Furnace Slag

Gradients	Type of Material	Source of Material	Average Specific Gravity	Water Absorption	Material in Kg/Cum
Cement	OPC-53 Grade	Ultratech	3.15		195
Mineral Admixture	GGBS	----	3.04		195
Fine Aggregate	Natural Sand	----	2.65	3.74	711
Coarse Aggregate	10 mm Aggregate	----	2.84	1.55	464
Coarse Aggregate	20 mm Aggregate	----	2.85	1.29	616
Water	Potable Water	----	-----	-----	233

Concrete Mix Design – for Ordinary Portland Cement + Microsilica

Gradients	Type of Material	Source of Material	Average Specific Gravity	Water Absorption	Material in Kg/Cum
Cement	OPC-53 Grade	Ultratech	3.15		350
Mineral Admixture	Microsilica	Elkem	2.25		40
Fine Aggregate	Natural Sand	----	2.65	3.74	708
Coarse Aggregate	10 mm Aggregate	----	2.84	1.55	462
Coarse Aggregate	20 mm Aggregate	----	2.85	1.29	614
Water	Potable Water	----	-----	-----	233

Workability & Compressive Strength of Concrete –

Sr. No.	Mix Description	Workability		Compressive Strength		
		Slump, Initial in "MM"	Slump, after 30 min in "MM"	7 days Strength in "N/SqMM"	28 days Strength in "N/SqMM	56 days Strength in "N/SqMM
1	OPC (100%)	190	130	20.9	35.1	44.6
2	PPC (100%)	210	200	13.9	29.4	34.3
3	OPC (75%)+Fly Ash (25%)	200	190	12.9	32.8	41.0
4	**OPC (50%)+GGBS (50%)**	**230**	**200**	**11.0**	**31.5**	**39.8**
5	OPC (90%)+Microsilica (10%)	170	120	15.2	38.1	43.5

Durability of Concrete –

Sr. No.	Mix Description	Permeability in "MM"	Water Absorption Average	Hardened Concrete RCPT Test		
				Average Charge Passed, Coulombs	Chlorine Ion Penetrability Remark	ASTM 1202 Coulombs
1	OPC (100%)	13.5	3.23 %	4442	High	More than 4000
2	PPC (100%)	23.3	3.49 %	3511	Moderate	2000-4000
3	OPC (75%)+Fly Ash (25%)	14.5	3.92 %	4169	High	More Than 4000
4	**OPC (50%)+GGBS (50%)**	**19.0**	**3.67 %**	**1875**	**Low**	**1000-2000**
5	OPC (90%)+Microsilica (10%)	15.3	3.69 %	1329	Low	1000-2000

Chemical Analysis of Concrete Cube -

Sr. No.	Mix Description	10 % PH	Chloride Content, Kg/Cum	Water Soluble Sulphate, as SO3, %
1	OPC (100%)	12.57	0.098	0.9
2	PPC (100%)	12.52	0.073	0.7
3	OPC (75%)+Fly Ash (25%)	12.37	0.108	0.28
4	**OPC (50%)+GGBS (50%)**	**12.57**	**0.085**	**0.60**
5	OPC (90%)+Microsilica (10%)	12.55	0.095	0.79

After Interpretation of results, it is found that by replacing 50 % OPC by 50% GGBS, we are getting More Workability, Strength and Most Durable Concrete.
After these satisfactory test reports, we have decided to go for Laboratory on Wheel & Stationary Laboratory in Virar.

In our Concrete Test Laboratory on wheel, following equipments are fitted/available –

1. Compression Testing Machines	14. Concrete Test Hammer – Digital
2. Compaction Factor Apparatus	15. Vernier Calipers-Digital
3. Sieve Shaker – Hand Operated	16. Cylindrical Moulds
4. Aggregate – Sieves	17. Electronic Table top Balance
5. Sand – Sieves	18. Pharmas (17.5, 20, 25, 30 & 35 Litre.)
6. Cube Moulds (18 Nos.)	19. Measuring Jar
7. Slump Test Apparatus	20. Measuring Tape
8. Bulk Density Cylindrical Metal Measure Set	21. Scoops-SS
9. Elongation Gauge	22. Stop Watch-Digital
10. Flakiness Gauge	23. Helmets
11. PH Metre	24. Hand Gloves
12. Thermometers- Digital	25. Trays
13. Pycnometer	26. Aprons

In our Stationary Laboratory following equipments are available –

• Compression Testing Machines-Micro Processor Base	• Pharmas (20, 25, 30, 35, 40, 45 & 50 Litre.)
• Concrete Mixer – Pan Type	• PH Metre
• Accelerated Curing Tank	• Pycnometer
• Hot Air Oven- Digital	• Aggregate Crushing Value Apparatus
• Flow Cone And Table	• Concrete test Hammer – Digital
• J Ring Apparatus	• Vernier Calipers
• L Box	• Cylindrical Moulds
• V Funnel	• Electronic Table top Balance
• Electronic Platform Balance	• Thermometers- Digital
• Sieve Shaker – Motorized	• Concrete test Hammer – Digital
• Aggregate – Sieves	• Electronic Table top Balance
• Sand – Sieves	• Cylindrical Moulds
• Aggregate Impact test Apparatus	• Measuring Jar
• Buoyancy Balance	• Measuring Tape
• Cube Moulds (24 Nos.)	• Scoops-SS
• Slump Test Apparatus	• Stop Watch-Digital
• Bulk Density Cylindrical Metal Measure	• Hand Gloves
• Elongation Gauge	• Trays
• Flakiness Gauge	• Aprons

Ours Stationary Laboratory is used for Study & Research and not for commercial purpose
To promote Green Concrete to small contractors, builders & workers and make them aware and create confidence to use the green concrete at site, our team is visiting different sites.

At site we take our Laboratory on Wheel, and ask them to mix the concrete as they are conventionally mixing for so many years by using ghamelas/ pharmas. We check sand, aggregate and water used for mixing and the slump of concrete and cast the cubes. We convert the ghamelas volume to actual volume as we have kept in laboratory 17.5, 20, 25, 30 & 35 litre pharmas to know the mix they are using at site.

On site we are designing the mix based on the test conducted on available raw material and by giving the required capacity of pharmas, we are mixing the concrete at site by replacing 50% Ordinary Portland Cement by GGBS, crushed sand and SNF based admixtures to get the required slump. We check slump & cast the cubes.

We ask them to test the cubes at any Laboratory which is NABL accredited and check the results.

In this we have asked the manufacturer of GGBS to give the packing in 25 kgs so that they can directly replace 50% cement by GGBS of one 25 kg bag

The objective is to give the good, workable and durable concrete, without adding any cost and giving some cost saving.

The cost calculations per bag of cement- approximately –

Cost of Cement Bag (for 50 Kg) = Rs.320/- per bag

Cost of GGBS Bag (for 50 kg) = Rs.200/- per bag

Cost of SNF based Admixture = Rs. 80/- per Litre

Cost of Cement (50%-25 Kg) = Rs.160/-

Cost of GGBS (50%-25 Kg) = Rs.100/-

Cost of Admixture (350 ml per bag) = Rs. 28/-

Total cost per bag = Rs. 288/-

Saving per bag of cement = (320-288) = Rs.32/ - per Bag.

We are completing our mission –

a)Ecological – Reduced carbon footprint by using bye product.

b)Economical – Cheaper than Cement & is replaced 50%.

c)Workable – Increases workability.

d) Durable – Very low Chloride Ion Penetrability.

In doing all of the above, we are not charging a single rupee for our services. It is our social cause and small efforts to make rural people aware and small step towards "Green India -Green Concrete"

Design Mix – Green Concrete -

For one of the project in Virar (East), where we have designed Green Concrete by replacing 50% OPC by 50% GGBS and used Crushed sand. Grade of Concrete is M30. Total 6000 bag Concrete

(3000 bags Cement + 3000 bag GGBS) is done by using 1 Bag Mixer.

Mix Proportion –

- Grade of Concrete = M30
- Cement – OPC-53 – Ultratech = 25 Kg
- GGBS = 25 Kg
- Engineered (Crush) Sand (Zone-2) =50 Litre
- Aggregate – 10 mm =35 Litre
- Aggregate- 20 mm =40 Litre
- Water =18 Litre
- Admixture- Zentrament FRV (MCB) =0.4 Litre
- Slump – Initial =200 mm
- Slump after 30 minutes =185 mm

Results of Mix done on various days from NABL Accredited Lab –

Sr. No.	Cube Identification	Date of Casting	Date of Checking	Age of Cube	Group-1, Average Strength, N/SqMM	Group-2, Average Strength, N/SqMM
1	Trial Cubes casted at Site for Mix Design as per site condition	05.05.16	06.05.16	1 day	43.03 (by Boiling Water Accelerated Curing- Equivalent 28 days)	
		05.05.16	13.05.16	8 days	33.3	----
		05.05.16	02.06.16	28 days	40.4	----
2	Raft	18.05.16	02.06.16	15 days	39.6	38.3
3	Raft	19.05.16	03.07.16	45 days	47.7	48.8
4	Raft	21.05.16	05.07.16	45 days	43.3	43.0
5	Column	28.05.16	12.07.16	45 days	33.9	----
6	Column	29.05.16	13.07.16	45 days	37.6	----
7	Column	30.05.16	14.07.16	45 days	45.6	----
8	Column	01.06.16	16.07.16	45 days	37.6	----
9	Column	02.06.16	17.07.16	45 days	45.8	----
10	Column	03.06.16	18.07.16	45 days	46.5	39.8
11	Column	04.06.16	19.07.16	45 days	41.7	45.8
11	Lift	07.06.16	22.07.16	45 days	45.2	----
12	Lift	09.06.16	24.07.16	45 days	39.6	45.9

Results of Core Cut of Concrete done at site from NABL Accredited Lab –

Sr. No.	Core Identification	Date of Casting	Date of Checking	Age of Core	Compressive Strength, N/SqMM
1	C39	06.06.16	13.06.16	7 days	33.8
2	C9	03.06.16	13.06.16	10 days	35.9
3	C19	29.05.16	13.06.16	15 days	41.3
4	C53	28.05.16	13.06.16	16 days	40.7

Summary –

- 50% Ordinary Portland Cement can be replaced by GGBS.
- GGBS can be directly added in 1 bag concrete mixer.
- Rotation of drum of Mixer should be minimum 90 seconds after addition of all the ingredients to get uniform mixing and results.
- SNF based Admixture should be used in concrete to get the workability i.e. Slump of 180 to 200 mm at site and the design strength by reducing the water content.
- By adding GGBS + Admixture in Concrete there is a overall saving in the cost.
- Using GGBS, Concrete will be –

Ecological - Reduces Carbon Footprint.

Economical – GGBS is much cheaper than Cement.

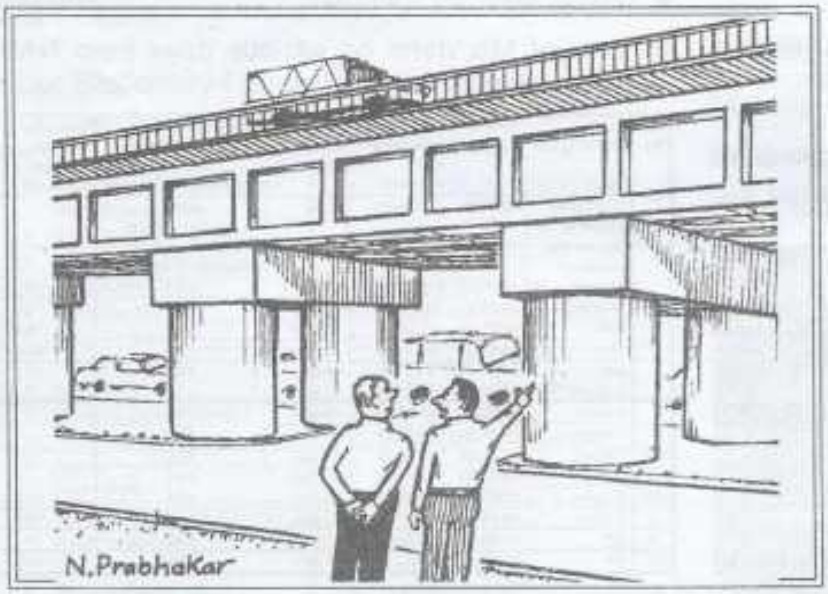
Workable – get more workability.

Durable – Less Chloride Ion Penetrability, will reduce corrosion of reinforcement.

Author

Paresh Unnarkar
RCC Consultant,
E-mail-paresh@unnarkarsgroup.com

"Courtesy Indian Concrete Journal"



I do know that this is massive, but what can I do as the contractor's designer ? All the minimum dimentions of members are specified by the department.

"Some architects are insisting on certificates from Structural engineers on quality , workmanship and material testing citing a reference to CE DP circular CHE/DP/49/Gen/ 2015-16 Dt 29-12-2015.

ISSE delegation consisting Mr. D S Joshi- President, Mr. S G Dhamadhikari, Hemant Vadalkar and Chetan Raikar had meeting with CE DPP at MCGM office on 4 Jan 2017. It was clarified by CE DP that such certificates are not asked by MCGM.

ISSE members should take a note of this fact. Soft copy of Manual of Building approval Version 1.1 is available on MCGM site."